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METALLURGICAL PROJECT

A. H. Compton - Project Director
R. S. Stone, M.D. - Associated Project Director for Health

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CLINTON LABORATORIES

H. D. Whitaker - Director
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HEALTH DIVISION

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HEALTH-PHYSICS SECTION OF HEALTH DIVISION

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BIOLOGY SECTION OF RESEARCH DIVISION

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REPORT FOR MONTH ENDING AUGUST 31, 1944

Received Clinton: 9/2/44
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M. Shulley

For: H. T. Gray, Director
Laboratory Records Dept
ORNL

OK 9/2/44
11/8/45

[REDACTED]



| | | |
|--|--|--|
| Bldg. 706A - <u>Room 54</u> - East Hood | | $1.59 \times 10^{-8} \mu\text{gm/cc}$ |
| Outside East Hood next day | | $1.42 \times 10^{-10} \mu\text{gm/cc}$ |
| West Hood | | $6.99 \times 10^{-10} \mu\text{gm/cc}$ |
| Outside West Hood | | $1.61 \times 10^{-10} \mu\text{gm/cc}$ |
| North Hood | | $7.27 \times 10^{-10} \mu\text{gm/cc}$ |
| <u>Semi-works</u> - Cell #4 | | $4.55 \times 10^{-8} \mu\text{gm/cc}$ |
| Outside Cell #4 | | $9.55 \times 10^{-11} \mu\text{gm/cc}$ |
| Cell #3 | | $1.09 \times 10^{-9} \mu\text{gm/cc}$ |
| Outside Cell #3 | | $8.39 \times 10^{-11} \mu\text{gm/cc}$ |
| <u>Room 15</u> - South Hood | | 1.49×10^{-9} |
| Outside South Hood next day | | $7.68 \times 10^{-11} \mu\text{gm/cc}$ |
| Bldg. 105 - <u>Room 201</u> Southwest Hood | | $1.39 \times 10^{-9} \mu\text{gm/cc}$ with fan off |
| | | $1.39 \times 10^{-11} \mu\text{gm/cc}$ with fan on |

The activity varied considerably from time to time in the above locations. Most measurements in product working areas indicated an activity of about $10^{-11} \mu\text{gm/cc}$. The α count due to radon and thoron products was subtracted from the total count in all measurements. The correction was accomplished by taking an α count a few hours after collection (after the radon products are negligible and repeating the α count the next day. The contribution of the product is given by the equation -

$$a = \frac{y_2 - y_1 e^{-\lambda t}}{e^{-\lambda t}}$$

in which $a \approx \text{c/m}$ due to product.

y_1 and y_2 are the first and second countings, t is the time between countings in hours, λ is the decay constant for thoron products and $= .0655 \text{ hrs}^{-1}$

10. Surveys

The radiographing and regrouting of the area around the experimental holes in the pile is continuing. In most cases a single regrouting seems to fill up the cavities sufficiently.

On August 1st a quantity of Cellamite was blown out of the 115 stack. This material was scattered over a considerable area and had a high activity. Decay curves indicated active isotopes of half-lives of about 1-1/2 and 16 hours.

Continued surveys revealed most working areas are at a safe level below tolerance. The most common defect revealed this month by the laboratory surveys was the lack of proper shielding about hoods and other working areas. There were several hot spills but they were cleaned up properly.

11. Atmospheric Radiation (J. S. Cheka, S. Block)

Measurements with the X-22 β and γ chambers are continuing on a routine basis. On several occasions an increase in air activity to about double normal background has been detected at a given location with portable counters. This was for short intervals during the chemical stack discharge. However, most of the activity as measured with the X-22 chambers is associated with pile stack discharge. This is what one would expect since the 24 hour Xenon-Iodine ionization from the chemical stack is negligible compared to the argon ionization of the pile stack (differs by a factor of 275).

An analysis of the X-22 data for the past two months indicates that the atmospheric activity has shown a continued increase. During this period the operations in the chemical extraction area have increased about 10% and in 10 about 60%. The higher activities followed definitely a position correlation with the wind direction but not with wind flow. Over the range at which measurements were made, i.e. about 1-1/4 mile, it seems that the radiation is more dependent on the elevation than on the distance from the stacks. The highest readings were at the highest stations with the exception of one station at the base of the stacks, which gave the highest values of them all. The average mr/week per station for the indicated time intervals is given in the following table.

| Time | Average mr/week/station | Range of Power | Total Energy of Pile |
|-------------|----------------------------|----------------|-------------------------|
| 6/12 - 6/17 | .180 | 1 - 1.06 | 1 |
| 6/19 - 6/24 | .225 | 1.03 - 1.06 | 1.04 |
| 6/26 - 7/1 | .258 | 1.06 | 1.02 |
| 7/3 - 7/8 | .318 | 1.06 - 1.15 | 1.13 |
| 7/10 - 7/15 | .309 | 1.05 - 1.18 | 1.26 |
| 7/17 - 7/22 | .316 | 1.12 - 1.59 | 1.14 |
| 7/24 - 7/29 | .343 | 1.62 - 1.82 | 1.55 |

Another interesting observation is that the radiation is consistently greater during the day than the night. For example, one typical station during June gave an average reading of .0051 mr/hr during the day and .0035 mr/hr during the night.

12. Water Surveys (D. J. Rendell)

The β and γ activity of the holding pond effluent continues at a safe level of about 4 mr/hr. The water in White Oak Lake is about background.

A new difficulty has developed. An algae which seems to have a selective absorption for some of the active products is collecting on the surface of the holding pond, White Oak Lake and below the lake. The following readings were made with a Lauritsen placed on the ground at the four corners of the holding pond near the edge of the water:

| <u>Date</u> | <u>NW</u> | <u>NE</u> | <u>SE</u> | <u>SW</u> |
|-------------|-----------|-----------|-----------|-----------|
| 8/23/44 | 63 mr/hr | 23 mr/hr | 15 | 7 |
| 8/24/44 | 46 | 22 | 40 | 50 |
| 8/25/44 | 22 | 75 | - | 90 |
| 8/26/44 | 101 | 15 | 28 | 102 |

It was observed in every case that the high readings occurred when the algae was close at hand, and was a function of wind direction. Firemen have been beating the algae down with water from a fire hose. Two algae samples were collected from the overflow of White Oak Lake. They were checked with a β counter and found to contain $2.93 \times 10^{-3} \mu\text{c/gm}$ dry weight and $3.42 \times 10^{-3} \mu\text{c/gm}$ respectively.

At present there is a large amount of this hot algae washing down into the Clinch River system. Steps are being taken to try to kill this algae or to fish it from the water. A boat has been secured which is aiding in collecting samples from White Oak Lake. It is expected that this boat will be used in cleaning out the overflow screens and removing the algae from White Oak Lake.

13. Mud Samples (D. J. Rendell and S. Farnakes)

The activity of the mud in the White Oak system has increased continually. It is difficult to make a good comparison of data because there is often considerable variation in activity of samples from the same location. However, the following table points out the general trend:

| <u>Location</u> | <u>Activity in $\mu\text{curies/gm.}$</u> | | | |
|---|--|----------------------|----------------------|----------------------|
| | <u>6/19</u> | <u>7/4</u> | <u>7/26</u> | <u>8/22</u> |
| Upper end of small pond near south gate | 1.2×10^{-4} | 2.9×10^{-3} | | 2.7×10^{-2} |
| Upper end of dyke pond | 3.1×10^{-3} | 4.3×10^{-3} | | 1.2×10^{-2} |
| Lower end of dyke pond | 4×10^{-4} | 4.7×10^{-2} | 2.6×10^{-2} | 5.6×10^{-2} |
| Upper end of White Oak Lake | | 1.0×10^{-4} | 6.4×10^{-4} | |
| Near overflow from White Oak Lake | 4.4×10^{-5} | | | 3×10^{-3} |
| Just below White Oak Lake | 4.5×10^{-6} | 4.7×10^{-6} | 4.2×10^{-5} | 2.3×10^{-4} |

14. Training Program (C. M. Patterson)

A new training program is underway to train 15 new Hanford trainees and nine new S.E.D. men. The S.E.D. men are replacements for some of the personnel lost last month.

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METALLURGICAL PROJECT

A. H. Compton - Project Director
R. S. Stone, M. D. - Associated Project Director for Health

CLINTON LABORATORIES

M. D. Whitaker - Director

HEALTH DIVISION

J. E. Wirth - Director

Medical Section of Health Division

J. E. Wirth, M.D. - Medical Director

Health-Physics Section of Health Division

K. Z. Morgan - Section Chief

RESEARCH DIVISION

R. L. Doan - Associate Director for Research

Biology Section of Research Division

H. J. Curtis - Section Chief

REPORT FOR MONTH ENDING OCTOBER 31, 1944

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Series A Issued: 11/2/44

Per Letter Instructions Of

FLD 1116

W. T. Gray

At: M. T. Gray, Supervisor

Laboratory Records Dept.

ORNL

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Same report as TDR 177

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8. Surveys (W. H. Ray)

Most of the surveys were of a routine nature this month. Only those things of special or unusual interest will be mentioned here.

A broken slug jacket caused the contamination of the new large fans in Building 115. There was considerable maintenance work in Bldg. 115 in October, which resulted in special decontamination problems. Canvas gloves were too porous and not sufficiently moisture resistant for this operation. Leather or rubber gloves should be used in the future. Most of the contamination was mixed with grease and oil so kerosene or CCl_4 proved very effective in removing the hand contamination. The Protection built into Building 115 by thick concrete walls is now justified, in view of readings up to 1000 mr/hr obtained in the fan areas but not in the operation areas. In the 105 canal, the water and the canal fixtures became rather contaminated. Some of the canal poles and underwater tools had to be decontaminated or replaced.

On September 29, 1944, there was an 8.8 inch rain in 24 hours at Clinton Laboratories. Flood conditions reached a critical state about 4 PM when the flood water from White Oak Creek began to wash over and through the new holding pond. The hard rains had beaten the algae to the bottom of the pond before the flood started, so probably only a small amount of active mud and algae was washed down stream. Bulldozers were used in emergency action to erect a dyke which was completed about 5 PM. If this had not been done it is possible that a good part of the settling pond together with all its active material might have washed down stream. White Oak Lake became full and was discharging over the flood apron at its maximum rate. At 5 PM the level of the water rose to within 1 ft. of the top of the dam, while it was still rising at a rate of 1 ft. an hour. Fortunately at this critical moment the rain subsided and saved White Oak Dam. Continuous readings were made of the water activity from White Oak Lake during the night of the flood and throughout the next day. The dilution factor was increased so many fold that the actual activity of the water during this period did not increase above the normal background values. The mud activity down White Oak Creek indicated a considerable decrease the next day due to the flushing action of the flood. An analysis of the muddy water showed a large increase in the barium and strontium concentration in the water which might have been serious had it remained at this level. After about a week the water had cleared up and the rate of flow and water level were back to normal.

The stream bed is being widened near the settling pond and a 2 ft. dyke built around east and south sides of the settling pond. This should protect the settling pond in the future. Consideration is being given to the construction of overflow outlets at the White Oak Dam (to prevent washing out) in case of another slightly greater flood.

9. Water Surveys

The water activity has varied considerably during the month. The inlet water to the settling pond averaged a gamma activity of about 4 mr/hr

and a beta activity of about 2 mr/hr. On occasions however these values went as high as 30 mr/hr and 10 mr/hr respectively. The outlet water averaged about 1/10 the activity of the inlet water. The gamma activity of White Oak Lake water averaged about 0.01 mr/hr (maximum reading .017 mr/hr, minimum reading was below background)

10. Mud Samples

The mud activity just above White Oak Lake dam has decreased from $\sim 10^{-3}$ $\mu\text{c/ga}$ to $\sim 10^{-4}$ $\mu\text{c/ga}$ since the flood. The activity of the mud below the dam does not seem to have been changed by the flood.

11. Work for the Coming Month

1. Routine work will consist of the following.
 - a. surveys of all plant areas
 - b. Meteorological surveys
 - c. Water, mud and algae surveys
 - d. Pocket and Badge meter service
 - e. Neutron and finger meter service
 - f. Hand and shoe counting (alpha, beta and gamma)
 - g. Laundry monitoring
 - h. Product surveys
 - i. Instrument calibration
 - j. Shift surveys
2. Work will continue on product decontamination procedure for the laundry.
3. New Health-Physics instruments that are developed by this Section, the Instrument Shop and English's Section will be tested.

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Contract No. W-7405 eng-39

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HEALTH DIVISION

and

BIOLOGICAL SECTION OF THE RESEARCH DIVISION

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REPORT FOR MONTH ENDING FEBRUARY 15, 1945

J. E. Wirth, M. D. - K. Z. Morgan
and H. J. Curtis

Series A Received: 2/27/45

Series A Issued: 2/27/45

DECLASSIFIED Per Letter Instructions Of
T/D-1086

3-17-55 *Mc Brown*
for H. J. Morgan
SUPERVISOR LABORATORY RECORDS
ORNL

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CLINTON LABORATORIES

HEALTH DIVISION

and

BIOLOGICAL SECTION OF THE RESEARCH DIVISION

ABSTRACTS

I. Medical Section of Health Division

None

II. Health-Physics Section of Health Division

A beta calibration of badge meter film (552-4) indicates that it is one third as sensitive to beta rays from P_{32} as gamma rays from Ra. The paper window on the badge meter absorbs 16% of the beta radiation.

Citric acid removes 90% of alpha, beta and gamma contamination in clothing.

Polonium activity in the air was measured in the pile building during the removal of a bismuth brick from the pile, and found to be ten times tolerance concentration. Plans are being made to have the bismuth bricks encased in aluminum.

Efforts are being made to make satisfactory measurement of the neutral particle radiation in the pile building. Present indications are that there is no health hazard presented by the neutrinos and mesotrons. Tolerance limits have been set for the fast and the thermal neutrons and satisfactory instruments are available for measuring their intensity. Efforts are being made to find out more about the slow neutron problems.

Sky shine experiments and calculations are in progress.

Spindle oil is being employed with good results in decontaminating the hoods.

The new foot counters have been installed. They are connected as an integral part of the Parker four-fold hand counters.

A new alpha survey proportional counter has been developed by English's Section. Preliminary tests indicate that it is a very satisfactory instrument.

The activity of the rain water collected down wind from the plant is very low, but rather definitely correlated with plant operation.

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The activity of the drainage water in White Oak drainage system has steadily decreased since the Separations Building (205) operations have been discontinued.

The clean-up in the Separations Building (205) has been very successful. Most areas in the cells and pipe tunnel have been reduced to a surface contamination of less than 12.5 mr/hr. Only a few spots have a remaining alpha contamination indicated by $> 50,000$ d/m.

Precipitron collection tests in Building 706C indicate the presence of barium contamination in the air.

III. Biological Section of Research Division

Blood studies are now nearly complete on the rabbits exposed to beta rays. It appears that there is no marked change in any of the blood constituents following irradiation with doses as high as the median lethal dose.

One series of 12 mice has now been receiving beta radiation at a rate of 500 r/day, 6 days per week, to the total surface for the past 11 weeks. They have accumulated 35,000 r, and to date the mortality has been no greater than in the controls. This would seem to indicate that the recovery from the acute effects of beta rays may be very much faster than from x or gamma rays.

CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

Report by J. E. Wirth, M. D.
Medical Director

1. Medical Activities

- (a) Pre-employment, termination and transfer examinations have continued on a higher level.
- (b) Dispensary service continued on a 24 hour basis. The personnel illness rate (as determined by the Disability Salary figures) has almost doubled during the last two months, in comparison with the previous year's average. Whether this is due to an actual increase in illness at this time of year, or to the fact that employees have now been on the payroll for a sufficient length of time to take advantage of the increased amount of illness leave available to them has not been determined.

2. Clinical Laboratory

Routine blood counts and urinalyses are being continued at a constant level.

3. Special Hazards

- (a) Hand Counts. The increased number of four-fold hand counters on the plant has been useful for earlier discovery and treatment of hand contamination. One of these counters has been set up in the Medical Department and for the last month all people reporting for blood counts, likewise have a routine hand and foot count. This procedure has brought to light a few unsuspected instances of contaminated hands. Such occurrences give the Medical Department an opportunity to talk with the individuals in an attempt to prevent such contamination in the future.
- (b) Clock Alley and Restricted Area Gate Monitoring. Frisking type instruments for the clock alley and the Restricted Area gates will soon be installed, as the project has been approved.
- (c) Shut-down of Chemical Separations Plant. The gradual shut-down of the Chemical Separations Plant (200 Area) has afforded an excellent opportunity to demonstrate how well such areas can be decontaminated without too great an effort and expenditure of personnel, and without hazardous exposure of personnel, provided proper prophylactic methods are used (such as assault gas masks, gloves, coveralls, etc.).

- (d) Personnel Contamination . The problem of making personnel in hazardous areas aware of the hazards and of the individual's ability to prevent over-exposure by such awareness is being worked on by the Medical Division. This entails almost individual instruction and it is believed that it is a hopeless task for the Medical Section to attempt by itself. The idea of prevention of contamination by good individual technique is slow to infiltrate through the minds of people handling the active materials. Monitoring services which show up contamination are not sufficient in themselves to prevent over-exposure. It is essential that the individual chemist or physicist develop a sufficiently accurate technique to eliminate all causes of contamination, except in those rare instances of accidental spills

- (e) See Health-Physics Section report for details.

4. Personnel

An increased amount of effort is being expended in an attempt to obtain additional physicians for the medical staff.

CLINTON LABORATORIESII. HEALTH-PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

I. Beta Calibration of Badge Meter Film (522-4): L. H. Weeks

Special type 522-4 film packs (without the badge meters) were calibrated for beta radiation from bakelite impregnated with P_{32} ($E_{av} \approx 1.69/3 = 0.56$ Mev). This bakelite source had been prepared and standardized by J. R. Raper of the Biology Section for the animal exposures. The intensity of this source in equivalent roentgens at its surface was determined by the use of an extrapolation chamber. The film packs (without the badge meters) were placed against the bakelite for a given exposure with the following results.

| <u>Exposure Density</u> | <u>Gamma exposure in roentgens</u> | <u>Beta exposure in equivalent roentgens</u> |
|-------------------------|--|--|
| .04 | .035 | .10 |
| .10 | .075 | .25 |
| .19 | .15 | .50 |
| .38 | .30 | 1.0 |
| .75 | .70 | 2.0 |
| 1.00 | 1.0 | 3.0 |

This data indicates that this film pack is about one third as sensitive to beta rays from P_{32} as gamma rays from Ra.

Badge meters of the type now in use were exposed, some with the paper window removed and others with it intact. The paper introduced a 16% absorption.

Two of the Biology personnel were monitored with this film during one of their routine operations. One received 2060 mr on the forehead and 130 mr on the left hand. The other received 860 mr on the forehead and 80 mr on the left hand. Measures have been taken to reduce this beta exposure.

II. Decontamination Laundry: J. E. Bradley, L. H. Weeks

Since the decontamination laundry began operations on April 25, 1944, acetic acid and igepal solution have been used for removing the radioactive contamination from clothing. Last November, experiments on a

laboratory scale indicated that citric acid was much superior to acetic acid for removing alpha contamination (See report from H. A. Moulthrop to K. Z. Morgan 11/18/44). Subsequent experiments on a production scale have continued to indicate the superiority of the citric acid, not only in removing alpha contamination but also in removing the beta and gamma contamination. The average results of a number of comparable washes indicate that acetic acid removes 10% of the alpha and 30% of the beta plus gamma. The citric acid removes 90% of the alpha and 90% of the beta plus gamma. The citric acid has a further advantage in that it is comparatively pleasant to work with and less difficult to handle. Plans are now under way to make the change over to citric acid as soon as possible.

III. The Polonium Hazard: K. Z. Morgan

The production of Polonium (RaF) from bismuth (RaE) has been under way on a small scale since operation began here in 1943. At first the samples were of the standard slug shape and size. They were placed into the regular slug chambers and pushed through the pile into the water canal. Some months ago large bricks (~ 4 x 4 x 12") of bismuth were placed in Hole 15 and these are now being forced from the south face of the pile when they are needed. The present plan is to place bismuth bricks in Holes 14, 15 and 18 and to increase the polonium production considerably.

On February 13th, a bismuth brick was removed from the south end of Hole 15 into a wooden tray with handles for holding it. A beta measurement at the surface of this brick indicated an activity on the surface of 65 r/hr. A single swipe of the brick with a paper towel gave an alpha count of 5000 disintegrations per minute.

Air samples were taken before and during the operation with an electrostatic precipitator at a distance of about 3 ft. from the Hole 15. After appropriate corrections were made for the radon and thoron products collected, the air samples collected before the bismuth operation began were only slightly above the counter alpha background of 8 c/m. The air sample taken during and immediately after the bismuth operation gave 1964 c/m. Since the energy (5.298 Mev) of polonium is about the same as that of product (5.16 Mev) and since the effective half life

$$(T = \frac{T_e T_r}{T_e + T_r} \text{ in which } T_e = \text{biological half-life and} \\ T_r = \text{radioactive half-life})$$

of polonium in the lung is probably about the same as for product, it is considered that the tolerance for polonium expressed in curies is the same as that of product. If we take the tolerance concentration of

product as 3×10^{-17} curies/cc of air (as given by H. M. Parker in CH1433) this likewise would be the approximate tolerance concentration for polonium. On this basis the air collected for 30 minutes during and after the removal of the bismuth brick (the bismuth brick was near the precipitron only a few minutes during the 30 minute collection period) was about 10 times tolerance concentration for one year breathing, at 24 hours per day.

The beta radiation hazard of RaE, as far as inhalation or ingestion are concerned, may be considered negligible compared to the alpha radiation hazard from a bismuth brick that has been in the pile a few months. This is true because

- 1) alpha tolerance is 1/10 of beta tolerance
- 2) average beta energy is $\approx 1.17/3 = 0.4$ Mev compared to the RaF alpha energy of 5.298 Mev
- 3) the body assimilation of bismuth is probably much less than that of polonium.

The polonium is known to concentrate in the spleen and kidneys and there is some indication that this element may have a negative biological half-life (concentrates in the kidney from the other body organs faster than it is eliminated) for the kidney for a month or more (See data by R. M. Fink, M-1551).

Plans are now in the making to remove the bismuth, which is at present in the pile, with a minimum of exposure to personnel and to encase the bismuth that is to be placed in the pile in the future. (For additional information see letter from K. Z. Morgan to J. E. Wirth on 2/15/45).

IV. Neutral Particle Measurements in Pile Building (105): K. Z. Morgan W. H. Ray

- (a) Fast Neutrons are measured by means of Chang and Eng (the double ionization chambers), with a hydrogen chamber, and by the alpha-emulsion film which is worn by the 105 Building personnel. Tolerance for fast neutrons (2 Mev) is set by the recoil proton ionization in tissue as $200 \text{ n/cm}^2/\text{sec}$. Most of the pile has been rather well shielded for fast neutrons during the past few months. A few months ago fast neutron readings of $\sim 100\%$ tolerance were frequently observed during the routine surveys. Most of these fast neutron leaks have been plugged rather effectively and so far this year no readings in the working areas of $>18\%$ of tolerance have been reported. During

the last few months of 1944 there was an average of three persons every two weeks (when the alpha emulsion films were read) with as much as one day's tolerance exposure per two week period, as indicated by the tracks on the film. So far this year no one has indicated a day's exposure to fast neutrons in a two week period.

- (b) Slow Neutrons as yet are not being measured. These neutrons do not possess sufficient energy to product proton recoil ionization and their energy is too great to present a large probability of capture resulting in neutron-gamma radiation. Therefore, it has been most generally assumed that these neutrons do not present any biological hazard. Dr. L. B. Borst (in a letter to R. S. Stone 1/31/45) points out the fallacy of this argument and suggests that the disrupting of the molecules producing hydrogen recoils and other energy exchanges in the body may present a biological hazard. At present no instruments are available for measuring this radiation and no tolerance values can be set. Dr. Borst suggests several methods by which such particles could be detected and consideration is being given to the construction of such an apparatus.
- (c) Thermal Neutrons in the working area are measured by the Health-Physics Section with foils, Lauritsens lined with cadmium, Lauritsens inner-lined with boron, and with proportional counters. It is believed that the regular pocket meters and badge meters worn by the 105 personnel measure rather effectively the slow neutrons received by the body from the neutron-gamma reaction, unless the radiation is in narrow collimated beams. The tolerance for thermal neutrons is $1650 \text{ n/cm}^2/\text{sec}$ and is determined from the capture cross section of the hydrogen and nitrogen in the body. The large number of thermal neutron measurements in Building 105 during the past few months have emphasized the necessity of taking such readings. In general the thermal neutron level in the working area about the pile comprises less than half of the total biological hazard. However, it is not infrequent that beams are found around the holes in the pile where the radiation level is 20 to 30 times tolerance and is comprised mostly of thermal neutrons. In the 105 Building, the tolerance working time should never be specified for an area near the pile without first measuring the beta plus gamma plus thermal neutrons. In some cases the fast neutrons should be measured also.
- (d) Heavy Mesotrons (neutral) have been searched for but no component above cosmic ray background has been detected with a coincident GM circuit.
- (e) Light Mesotrons (neutral) have been measured for the past month but the results are not conclusive as to their origin. In these

measurements the primary particles pass through 12 inches of lead and produce low energy particles of < 10 Mev, which in turn produce coincidences in 3 thin-walled GM tubes when their axes are in the same plane. The direction of this GM telescope is not critical, so the secondary particles must be produced by a "radiation" process from the primary particles, which takes place in the plane of the GM tubes. This radiation is not detected when the GM tubes are out of line or when they are surrounded by brass tubes. The pile has not been cut down sufficiently during these experiments to state that this light mesotron is produced in the pile. The present evidence seems to indicate that most, if not all of this radiation can be attributed to cosmic radiation.

- (f) Neutrinos are produced in large numbers in the pile (if the neutrino theory is correct) and Dr. L. B. Borst has indicated that one would expect them to account for about 10% of the pile energy. The Chang and Eng apparatus should be capable of measuring the neutrino-hydrogen scattering if neutrinos present a biological hazard at Clinton (see report by E. O. Wollan, CP-1140) but present measurements have not indicated such a hazard.

V. Sky Shine: R. R. Coveyou

During the past month, very intense sources of radiation (gamma and beta in one case, pure beta in another) were available for Health-Physics experimentation. Extensive measurements were made, but, due to the present unavailability of an accurate assay of the very intense gamma source used, the critical calculations have not been made. Preliminary indications are that the single theory of TNX-7 (W.J. Wende) is not completely verified, probably due to neglect of secondary scattering from the air and ground. This leads naturally to the conclusion that the values there given are of the right order of magnitude, but that some corrections must be made. More careful analysis of the data obtained is in progress, and a complete report of this work will be made soon.

VI. Decontamination of Hoods: W. E. Waters

Spindle oil (Prorox C, Socony-Vacuum) has been employed with excellent results as an agent for product decontamination of hoods and other equipment.

A spray gun, of the type commonly used with insecticides, was equipped with rubber tubing which was connected to the compressed air line. Only a sufficient air pressure must be used to ensure a steady stream of vapor and caution must be observed not to use great enough pressure to cause blowing of the dust.

After the first oil treatment, 30 minutes should be allowed for the oil to "rinse down" the surfaces. Next the surfaces are wiped down several times with clean rags that have been previously soaped in spindle oil and wrung dry. Frequently a second oil treatment is desirable. If the surface is to be painted, it should be washed down with soap and water. A large number of hoods have been cleaned of product by this procedure and careful measurements before and after the cleaning indicate that there is an 88% removal by a single oil treatment. (W. E. Waters to K. Z. Morgan 1-27-45)

VII. Foot Counter

Foot counters constructed in J. R. Brand's Section are being connected to the Parker four-fold hand counters so that both units are operated by the same timer. The foot counter register is coupled to the four-fold register by a sprocket chain so that both instruments can be reset simultaneously. In order to take a count, the operator resets the recorders, steps upon a foot stand (containing two GM tubes) and places his hands in the hand counter pockets. The weight of the hands in the hand counter pockets closes a micro-switch and starts the circuits operating. The count runs for 24 seconds and is cut off by the timer. The operator records his name and the five numbers on the recorders. The four hand counter units operate "Scale of 8" circuits, and to get the counts per minute one can multiply these readings by $60/24 \times 8 = 20$. The foot counter operates a "Scale of 128" and to get the foot count one can multiply this reading by $60/24 \times 128 = 320$. The geometry factors are determined separately for each unit. All these units are working very satisfactorily. (For further information see letter from G. S. Pawlicki and W. L. Dennison to K. Z. Morgan 1/16/45).

VIII. New Alpha Survey Instruments: R. Firminhac

A very promising trial model of a sensitive alpha survey instrument is being used in the clean-up of the cells of the Process Building (205). The instrument consists of a proportional counter designed by Borkowski's Group in English's Section, and a rate meter designed by Cpl. Chas. Marsh of J. R. Brand's Instrument Section. The proportional counter uses air as the gas and a 2 mil tungsten wire down the center of an aluminum cylinder 8-1/4" long and 1-1/2" outside diameter. A section of the cylinder wall is cut out and a screen is placed over the window. The geometry without a screen over the opening is about 45%, with 2700 volts on the center wire. The geometry can be reduced to any desired amount by sliding various screens in place over the opening. The amplifier is an ordinary 3 stage resistance coupled amplifier. The instrument is non-microphonic, insensitive to AC pick-up and the probe can be used with as much as 30 ft. of low capacity cable between it and the first tube.

The rate meter utilizes a No.2050 thyatron tube operating directly from the amplifier. The output of the thyatron is used to discharge a condenser, and the rate meter is a microammeter in series with the charging circuit of the condenser. The same charging circuit, regulated by a VR tube controls the bias of a pentode with a relay in the plate circuit in such a way that when the counting rate (charging current) reaches maximum on the microammeter, the relay drops out, shunting the meter and increasing its range several fold. This circuit also operates colored lights indicating which range is in operation. The circuit seems to be very stable and has reached a reasonable compromise in time constant between complete stability of the meter and time necessary for a reading at 200 c/m full scale deflection on the sensitive range.

It is planned to use this meter in combination with a cylindrical type hand counter using about the same chamber as is used in "Handie" but incorporating the proportional counter principle with a 2 mil wire center electrode.

A more portable alpha probe, using the proportional counter principle is being tested. It is hoped that an instrument of about the dimensions and weight of the present "Walkie-talkie" can be developed. Either a much better high voltage supply than is presently available is necessary, or a somewhat more complicated counting chamber will have to be used. Preliminary experiments show that gas mixtures at atmosphere pressure can be found which can be operated below 2000 volts, and perhaps below 1000 volts, with reasonable amplification and good long proportional regions.

IX. Atmospheric Radiation: J. S. Cheka

This work continued on a routine basis, showing results which were comparatively consistent with previous observations.

However, rain-count (β) data, which had been collected for some months was summarized and showed a few interesting points. In the 28 samples, collected between 9/19/44 and 1/13/45, and evaluated in $\mu\mu$ c/cc, the range was 0 to 0.33 $\mu\mu$ c/cc, the average being .090.

Grouped averages show the following results.

| | | | |
|--------------------------------------|--------------------|-------------------|--------------------|
| With "off-gas" | .151 $\mu\mu$ c/cc | without "off-gas" | .050 $\mu\mu$ c/cc |
| With E or NE wind | .123 $\mu\mu$ c/cc | otherwise | .059 $\mu\mu$ c/cc |
| With both "off-gas" and E or NE wind | .174 $\mu\mu$ c/cc | | |

NOTE: Rain guage was west of the stack.

The two highest values occurred when the wind was NE and about 1 mph. It was also noted that the time elapsed between storms seemed to have no bearing on the readings, indicating that any counts observed were obtained by emitters brought down by the rain rather than previously settled in the rain gauge.

With the cessation of 205 activity early in January, a drop in field activity of the X-22 chambers was noted. Total mr/mo/station dropped 11%, though 105 activity increased 8.5%. This is being checked further.

t The off-area integrons have served their purpose and will be removed to the Clinton Laboratories plant where it is hoped they will fill a more useful application. The integron houses will remain intact and will be available for housing more sensitive radiation indicators such as the recording GM circuit which now is located in the X-10 integron house.

X. Area Monitoring: W. H. Ray

In addition to continuance of atmospheric radiation study with the X-22 ionization chambers at off-site locations, increased attention has been given to the effluent of White Oak Creek.

A survey of White Oak Lake with a submarine GM probe found the water rather uniformly 100 c/m above background. As high as 1800 c/m were observed when the probe rested in the mud at the upper end of the lake. The results of this survey confirm the justification of the proposed GM recording counter to be mounted at the dam.

Since the 205 Separation Plant shut-down, the activity of the drainage water into White Oak Creek has steadily decreased. The composite sample of lake water collected throughout December showed a large percentage of Strontium. The activity was so low, however, that good determination of the percentage was difficult. A close watch will need be kept as plant processes change.

An experiment with mud samples to determine the self-absorption correction for various sample thicknesses showed that the self-absorption of each sample of mud must be determined separately for precise results. A mean was determined for a number of samples that might be used where a maximum of 35% error could be tolerated.

XI. Work Area Surveys: W. H. Ray

January has been marked by clean-up radiation exposure areas generally throughout the plant. The extensive cleaning efforts about the 200 Area have required an additional surveyor part time.

Cleaning of all cells in 205 has been successful, although the goal of 12.5 mr/hr has been found impractical to reach in a few cases. Exceptions are very localized spots in Cells 1, 2, 3, 7 and the pipe tunnel. These are all less than 50 mr/hr, except one spot in the pipe tunnel which is about 100 mr/hr. The men engaged on the cleaning job wore overshoes, coveralls, gloves, safety glasses and caps. When precipitron measurements indicated the presence of product contamination, Army Assault Masks were worn. (For detailed information see report of R. A. Simons to K. Z. Morgan 2/13/45)

Alpha contamination has been found in some cells but has been reduced to below 50,000 disintegrations/minute (on Pluto) without recourse to paint except for two spots in Cell 4.

Routine surveys in 706 A have continued to locate various points of contamination. Persistent search in an area of this type seems necessary to keep things in good order.

Indium foil surveys have been made in the 105 Building to determine slow neutron flux at different points. The results of this survey required that increased shielding be used in the experiment on top of the pile.

A test with indium foil in the air duct from the pile building, where it enters the fan building, indicated the presence of a slow neutron flux of 6 slow neutrons per sq cm/second. The slow neutrons observed in the air duct from the pile are presumably slowed down delayed neutrons from product dust. This product dust is the result of contamination of the pile during several slug jacket failures in the past. It is believed that the mean life of the neutrons is not sufficient to account for the number observed in the air ducts. Special alpha emulsion film exposed at this same point in the air dust did not yield any positive indication of fast neutrons.

Precipitron tests on top of the pile revealed conditions requiring the use of respirators while the filing of tuballoy rods took place.

As high as 32 beta plus gamma counts/minute/ft³ of air sampled have been found with a thin wall GM tube from precipitron tests in Building 706C with a run now in progress. Decay and absorption observations indicate that Ba and La are probably the active materials.

Considering the efficiency of the collection and counting systems, this activity, as indicated by 32 c/m, is about 1/2 of air tolerance concentration.

While smear tests are not considered quantitative, some experience indicates that the usual wipe contains less than 5% of the surface contamination, and under some conditions may fail to pick up the radioactive material sought.

Regular surveys and survey services continue to increase as better coverage of the Restricted Area is achieved. This was possible only by greater effort on the part of the surveyors as they gained in experience. Irregular events, along with vacations and absences, demand a versatile crew, if minimum operations are to be performed without a reserve of man power.

CLINTON LABORATORIES

III. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief

A tissue laboratory is being set up where pathological material can be fixed, stained and sectioned. This is being done with the help of Miss Richmond of the Chicago group in the hope that the techniques used at the two laboratories will be identical. Histological material will still be fixed here and sent to Chicago for staining, sectioning and examination. We hope to start a pick-up service within a few days which will pick up dead animals throughout the night and in that way obtain a great deal more pathological material. We are especially interested in obtaining as much information from the chronic series as possible.

1. Biological Effects of Pile Radiations: R. E. Zirkle, P. S. Henshaw,
E. F. Riley, G. E. Stapleton.
 - A. Effects of Small Periodic Doses of Slow Neutrons on Mice (142-X10B)
Final preparations for starting this series are now complete and it should begin in a few days.
 - B. Biologic Effects of Single Doses of Slow Neutrons on Mice (142-X11B)
A great many of these animals have been exposed and we are now awaiting developments.
 - C. Effects of Small Periodic Doses of Hard Gamma Rays on Mice (142-X123)
The work on this problem was started 9/27/44 and more series are being added as more mice and facilities become available. There have been no significant changes yet in any of the groups.
 - D. Effects of Small Periodic Doses of Fast Neutrons on Mice (142-X13B)
A summary of the mortality data for this series is shown in Table 1. It will be observed that for the series which has been running since July 1944 the accumulated dose is about 185 n and the mortality in this series is well over 50%. This result is to be compared with the single dose of 90 n which produces acute death in 50% of these animals. Mice of a different strain (LAF₁) at N.C.I. have been exposed to gamma rays at a rate of 8 r per day, a nearly equivalent dose based on acute killing, and have accumulated about five times the median lethal dose for gamma rays without showing very high mortality. Whether this indicates that there is a real

TABLE I

142-X13B. Effects of Periodic Exposure of Mice
to Fast Neutrons at 1.15 n/day

Carworth Strain CF₁

| Sex | Irradiated Animals(XC) | Control Animals(XC) | Date Begun | Total Dose | Orig. No. | Mortality | | | | | |
|-----|---------------------------|------------------------|---------------|---------------|--------------|------------|------|-------|---------|------|-------|
| | | | | | | Irradiated | | | Control | | |
| | | | | | | Acc. | Sac. | Other | Acc. | Sac. | Other |
| F | 52643-68 | 52721-46 | 6/27/44 | 191 | 26 | 1 | 4 | 19 | 3 | 4 | 5 |
| F | 52669-94 | " | " | 191 | 26 | 3 | 4 | 12 | 3 | 4 | 5 |
| F | 52903-20 | 52928-52 | 7/3/44 | 185 | 25 | 1 | 4 | 14 | 0 | 4 | 3 |
| F | 53078-102 | 53103-27 | 7/7/44 | 180 | 25 | 0 | 4 | 14 | 3 | 4 | 2 |
| F | 57419-44 | 57271-96 | 12/5/44 | 56 | 26 | 0 | 1 | 0 | 0 | 2 | 0 |
| M | 52953-77 | 53003-27 | 7/4/44 | 184 | 25 | 0 | 4 | 17 | 1 | 4 | 9 |
| M | 52825-50 | 52851-76 | 7/4/44 | 184 | 26 | 0 | 4 | 11 | 2 | 4 | 1 |
| M | 53257-81 | 53282-306 | 7/8/44 | 150 | 25 | 1 | 3 | 21 | 1 | 4 | 11 |
| M | 53568-86 | 53587-605 | 8/12/44 | 124 | 19 | 0 | 3 | 16 | 4 | 4 | 4 |

Strain A

| | | | | | | | | | | | |
|---|----------|----------|----------|----|----|---|---|---|---|---|---|
| F | 60064-83 | 60124-43 | 11/13/44 | 75 | 20 | 0 | 0 | 1 | 0 | 0 | 0 |
| F | 60104-23 | 60124-43 | 11/13/44 | 75 | 20 | 0 | 0 | 1 | 0 | 0 | 0 |
| M | 60043-63 | 60001-21 | 11/13/44 | 75 | 21 | 1 | 0 | 3 | 0 | 0 | 0 |
| M | 60377-88 | 60364-76 | 2/5/45 | 9 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |

difference between the acute and chronic manifestations of these two radiations cannot be answered until the series which we are running on a comparable gamma ray exposure level are farther along.

All of the mice in this series which have run over 150 n are emaciated, have thin, poorly kept fur, and are smaller than their controls. It is very significant that a number of these animals have developed opaque eyes. A number of malignancies (lung nodules, mediastinal masses) have occurred but no analysis has yet been made of this data.

A preliminary analysis has been made of the blood data for the mice on the 1.15 n per day level and it appears that the neutrophils are unaffected by the radiation but the lymphocytes are significantly decreased. These curves are shown in Figures 1 and 2. Again it will be necessary to await the results of the gamma ray series before the full significance of this result is apparent.

E. Delayed Effects of Single Gamma Ray Doses on Mice (142-X14B)

It is expected that exposures of this series will begin during the coming month.

F. Delayed Effects of Single Doses of Fast Neutrons on Mice (142-X15B)

Most of the animals in this series have been exposed and we are now awaiting developments.

2. Radioactivity of Animal Organs and Tissues after Slow Neutron Exposure (142-X16B): H. J. Curtis, J. Teresi

The experimental work on this problem has been completed and a full report will be issued in the very near future. Briefly, it has been found that the experimentally observed values of activity agree very well with the computed values. Sodium is the element giving rise to the major portion of the activity. This activity is far too low to be of any great significance when one is considering the total damage caused by slow neutron radiation. It is also too low to be of practical value for the diagnosis of slow neutron exposures in humans except in very extreme cases.

3. Metabolism of Short-Lived Fission Products (244-X1B): H. Lantz, J. Teresi

The work on this problem has been completed and a terminal report will be issued in the very near future.

Figure 1

Spec. Cont.
Cont.
Expt'l

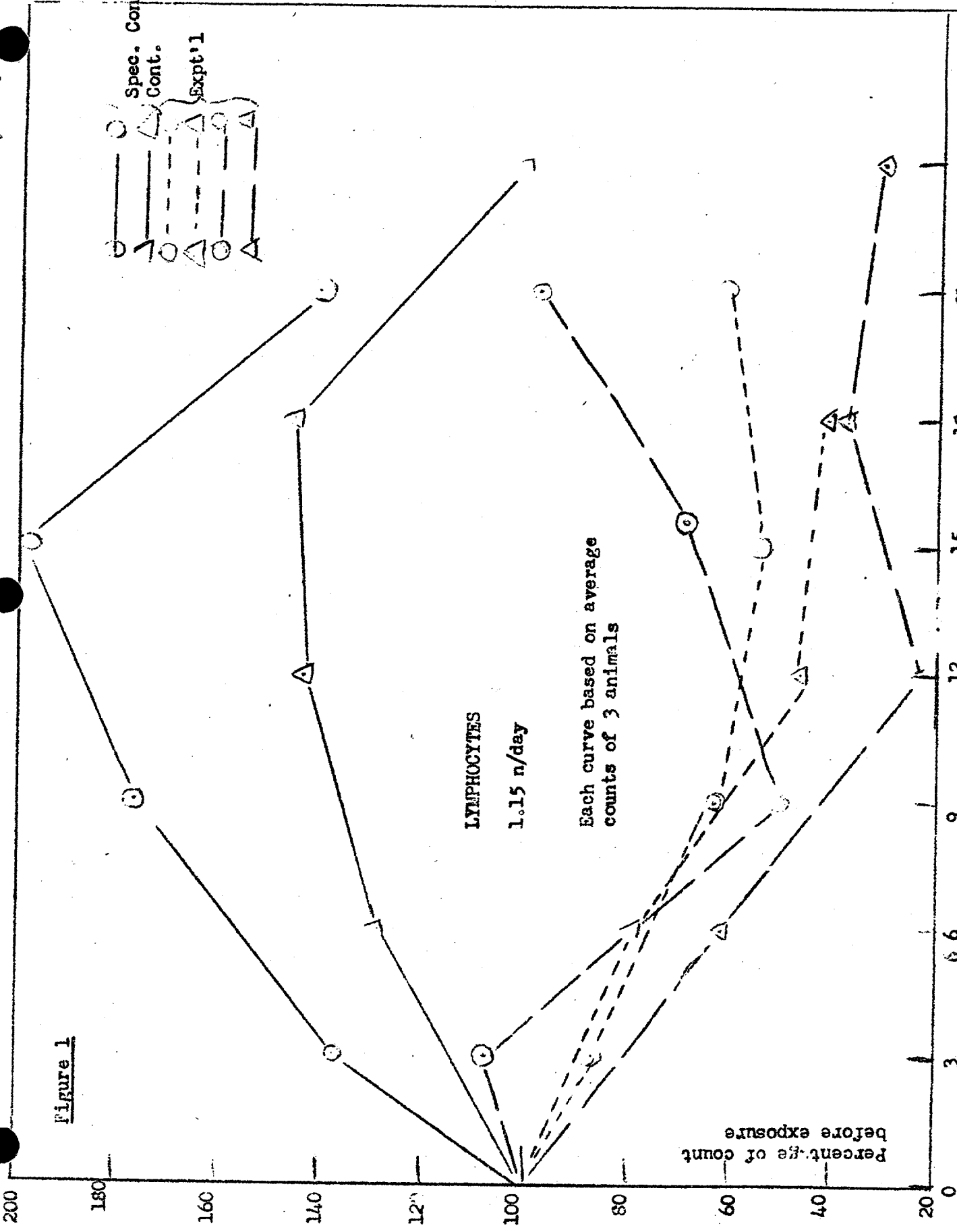
LYMPHOCYTES

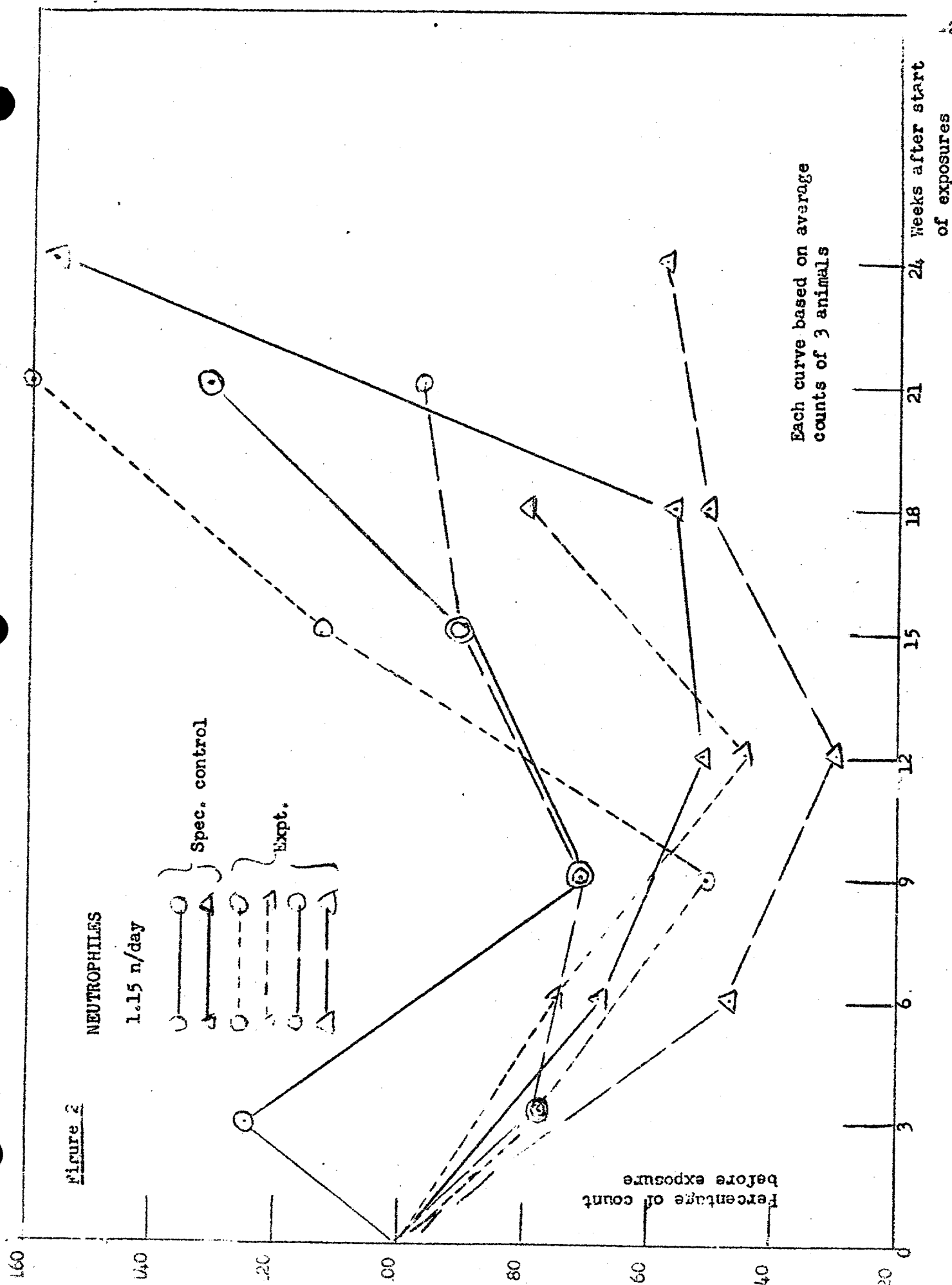
1.15 n/day

Each curve based on average
counts of 3 animals

Percent-ge of count
before exposure

24 Weeks after
start of exposures





4. Biological Effects of External Beta Rays (246-X7B): J. R. Raper, R. E. Zirkle
J. E. Wirth, K. K. Barnes

A. Blood Effects Following Beta Radiation. Preliminary data are now complete on the effects of beta radiation on the blood count. Rabbits have been used in this work. Two animals have been used at each of the following total surface dosage levels: 15,000 r, 10,000 r, 7500 r, 5000 r, 4000 r, 3000 r, 2500 r, and 1500 r. Counts were taken at 3 hours, 24 hours, 48 hours, 72 hours, 96 hours and weekly thereafter for 11 weeks. Total white counts and differentials were taken. It was not possible to distinguish the experimental animals from the controls with regard to any of the blood elements at any time. This result is of course in sharp contrast to that obtained by irradiation by x-rays, gamma rays or fast neutrons. It has some interesting possibility from the point of view of theoretical haematology.

B. Chronic Exposure to Beta Rays. Exposure to 500 r per day has continued on the mice started in November 1944. Seventy exposures have been made with an accumulated dose of 35,000 r. No deaths have occurred during the past month either in the treated animals or in the controls. The treated animals now show complete epilation on head and over entire back, skin erythematous with large sensitive thickened areas in a few cases and showing considerable thickening in the remainder, and general swelling of the nose and mouth. The condition of these mice appears generally good, the rate of weight gain being only slightly retarded.

The median lethal dose for acute death in these mice is 4700 r. This then represents an exposure of approximately 10% of the median lethal dose per day to give an accumulated dose of 7 times the median lethal dose. This is considerably more than would be expected with x-rays at a comparable dosage rate, and indicates that either the recovery from beta rays is much faster than for x-rays or else the skin has thickened during the radiation, or in some other way has built up a defense against this radiation.

5. Biological Monitoring (142-X3B). Elizabeth Anderson.

There has been an infection among the rabbits which has resulted in the death of four of the monitoring animals in the pile stack gas chamber, as well as a number of the controls. Tissues of the monitoring animals were found to be completely inactive radiologically.

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[REDACTED] FOR THE INFORMATION CONCERNING THE
[REDACTED] AND THE UNITED STATES OF AMERICA
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[REDACTED] [REDACTED] [REDACTED]
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ABSTRACTS

I. Medical Section of Health Division

none.

II. Health-Physics Section of Health Division

The regular badge meter film was placed in water tight cellulose acetate holders for under water measurements.

Polonium activity in the air during the removal of a bare bismuth brick from the pile reached a maximum of 44 times tolerance. All bismuth bricks have been canned in aluminum.

The GM counter consistency tests seem to give reasonably consistent results.

A summary of the data on the radioactivity of the mud in the White Oak Drainage system indicates results consistent with plant operations and meteorological conditions.

The aluminum liner is ~ 2.5 times more efficient than paper as a collector of radon and thorium products by the precipitron. The aluminum is ~ 1.5 times as efficient as paper as a collector of product.

A hydrogen pressure chamber, using a balanced tube circuit has been constructed for use in measuring fast neutrons.

The separation buildings (204 and 205) have been cleaned up satisfactorily from the standpoint of radiation hazard and have been placed in a stand-by condition.

Maintenance has placed in operation a "clean-up room" to handle the decontamination of tools, clothing and personnel.

III. Biological Section of Research Division

A preliminary report is given of the metabolic changes following total surface beta irradiation in rats. There is no change in metabolism for about 10 days following irradiation, but then the food intake, water intake and weight start to fall indicating a gastro-intestinal upset. After a few days the food and water intake

increases sharply, the water intake sometimes reaching three times the control level. At the same time the urine output may drop slightly and increase in specific gravity. At this stage there is usually albumen in the urine. This is the period of cellular destruction and these findings are indications of the damage. Recovery is taking place slowly and whereas after nearly three months these animals appear to be well on the road to recovery, their general metabolism is far from normal.

CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

Report by J. E. Wirth, M.D.
Medical Director

1. Medical Activities



- (a) The construction of the new hot laboratory, Bldg. 706D, is nearly complete and as a result pre-employment examinations have decreased. Termination and transfer examinations have continued on the same levels.
- (b) Dispensary service continued on a 24 hour basis. Personnel illness rate is continuing on the same rather high level.
- (c) A detailed survey of the water purification system has been completed and the system appears satisfactory for the present. The sewage disposal system is barely adequate and if operations are to continue over a prolonged period will need renovation or replacement by an entirely new system.

2. Clinical Laboratory

- (a) Routine blood counts and urinalyses are being continued on a constant level.

3. Special Hazards

- (a) White Oak Creek Dam: A survey has been completed by the project group to determine the necessity for repair of the dam. A large part of the fill on the dam is more heavily constructed than was believed. One section is composed mostly of dirt and will require reinforcement on the down surface to prevent gradual washing away with repeated high water levels. The down side surface of the bank near the spillway is being eroded by surface water from the road and will require gravel reinforcement.
- (b) Off-Area Integrations: Most of the out-lying off-area integrations have been discontinued. At no time have they showed any appreciable increase over background radiation in these areas.
- (c) Chemistry Building: A program of repair work to hoods and benches is nearing completion.
- (d) Bismuth Problem: All of the old bismuth bricks in the pile have now been canned in aluminum and arrangements have been made for all future shipments to be canned; thus eliminating the polonium hazard.

- 
- (e) Tuballoy: Tuballoy rods used in an experiment on top of the pile have become so thickly covered with oxide that their handling during replacement has become a hazard in that the oxide in the atmosphere, in some regions, has reached 2 to 3 times specified tolerance. Proper greasing will decrease the hazard and the wearing of masks should eliminate all danger to personnel.
- (f) New Alpha Survey Instrument: The new alpha survey instrument, known as the "Poppy" (mentioned in last month's report) has proved so valuable that a project for 22 has been requested. Fifteen of these will be retained by Clinton Laboratories and seven distributed elsewhere. It is so constructed that in addition to low levels of alpha activity, it can also be used for detecting beta and gamma radiations.
- (g) Hand and Foot Contamination: A general survey of hand and foot contamination is being obtained by having all individuals get hand and foot counts at the same time they obtain blood counts.
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CLINTON LABORATORIES

II. HEALTH-PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

I. Waterproofing of Film Packs: J. E. Bradley & L. H. Weeks

Several instances have arisen in which it would be desirable to obtain some film measurements of exposure that must be taken with the film immersed in water; namely (1) mud and water measurements to be taken in the settling pond, White Oak Creek and Lake, and (2) some special absorption tests to be made by R. R. Coveyou. In order to do this, it has been necessary to waterproof the film packs, or to develop a waterproof holder for the film, so that it may be left immersed in water for an indefinite period of time with no damage to the film.

Prior to this time, we have waterproofed small finger meter packs by the simple procedure of dipping them in melted paraffin and giving them a waterproof coating. However, although this method has proved satisfactory for these small packs, it has been difficult to coat the regular dental size packs to a sufficient thickness to insure waterproofing. For this reason, a waterproof holder for this size pack has been developed.

This holder is made in the following manner:

- (1) A film pack is placed in an ordinary cellulose acetate photo-pass holder which is already sealed at one end.
- (2) Another photo-pass holder (or some other cellulose acetate of equal proportions) is cut up and dissolved in acetone to form a solution of approximately the same consistency as glue or cement.
- (3) Some of this solution is spread between the edges of the open end, with great care being taken not to damage the film pack, and the sides of the open end are squeezed tightly together in a vise and allowed to harden.
- (4) The resulting holder has proved to be waterproof in tests where the pack has been immersed in water for one week.

Several control holders, with 1 mm of cadmium on one-half of each side of the film pack, have been made up in order to develop a new set of gamma standards for these films. Other tests are being made to determine the percentage absorption of beta by both the cellulose acetate

holder and the film pack itself. When these are completed, we feel that these film holders will be satisfactory for use in the desired experiments.

II. The Polonium Problem (K. Z. Morgan and A. T. Greenwood)

On February 27th two bare bismuth bricks were removed from Hole 15 of the pile and placed in a wooden shipping box with an inner lining of 1/2" lead. Readings with the probe meter near the surface of the bismuth bricks were 150,000 mr/hr. With the top on the box, the reading dropped to 105mr/hr (The boxes were poorly designed from the standpoint of Bremsstrahlen.) Precipitron readings made in the working area during this operation indicated an alpha activity (after correction for the radon and thoron products collected) of 4,440% of tolerance. The floor was cleaned with a vacuum cleaner several hours after the above operation was completed and this cleaning stirred up dust in the air to 200% of tolerance. All persons working with the bismuth operation wore Army Assault Masks, coveralls and gloves.

On March 5th and 6th, the bismuth bricks were pushed from Holes 14 and 15 in the south face of the pile into Aluminum cans. The highest precipitron reading during the canning of the bismuth bricks was 2630% of tolerance. On March 7th alpha contamination was found in most parts of the pile area of Building 105. The equipment was cleaned carefully and it was decided to paint the floors of the hot areas.

All bismuth bricks in the pile are now canned and all that are placed in the pile in the future will be canned before they are activated.

III. Application of Consistency Tests to Hand Counter (R. R. Coveyou)

Ref: See Memo R.R.Coveyou to K.Z.Morgan 1/1/45
"Test for Consistency of Counter-Scaler Units"

For some time past, daily consistency tests have been run on hand and foot counters located at various points in the plant. Although no completely conclusive trends can be demonstrated, it seems very likely that -

- (a) The standard samples used will give reasonably consistent results. This was shown where comparable factors were obtained by running tests with standards in one position throughout, and also re-running the test immediately afterwards with standards removed and replaced for each count.
- (b) Daily fluctuations in counter response were observed. This was shown by picking one particular count for each day as a

standard (the 10th count) and calculating the factor over a period of a month, using these figures. There are statistical uncertainties in the method though the uncertainty is reduced by remark (a) above. Further work on this point will be done.

IV. Summary of Mud Surveys (J. S. Cheks and K. Weber)

This is a summary of surveys of activity of mud in the White Oak Creek and Lake system which has been used for waste disposal at "X" since March 6th, 1944. Reports from 4/26/44 through 3/1/45 are included. Corrections have been made for the efficiency of the counting system and the self-absorptions of the mud samples. For purposes of comparison, sampling locations have been grouped as follows:

- A - includes all points between the settling and retention ponds and the area fence.
- B - covers the marshy section from the fence to about a half-mile below the fence.
- C - comprises all points in White Oak Lake.
- D - takes in locations between White Oak dam and the mouth of the creek at the Clinch River.

The attached graph shows the condensed results.

Drainage began through the retention ponds on March 6th, 1944. The summary on April 26th showed such high activity (including 1.28×10^{-3} $\mu\text{c/gm}$ in the Clinch River) that the retention ponds were deemed inadequate. Drainage through these was discontinued and the settling pond was constructed, being put into operation on July 3rd.

Algae, carrying a lot of activity, was noted escaping from the settling pond, and baffles at the outlet were installed late in August to prevent this. A drop in activity was subsequently noted throughout the system.

The flood of September 29th and the subsequent excavation of the creek bed (Section A) brought about a sharp drop in activity at A and a rise in all localities down-stream. The former is probably due mainly to the exposure of fresh earth at A, but the high values at B and below are probably produced by the flushing of silt from upstream and also the flooding and overflow of the settling pond on the 29th of September.

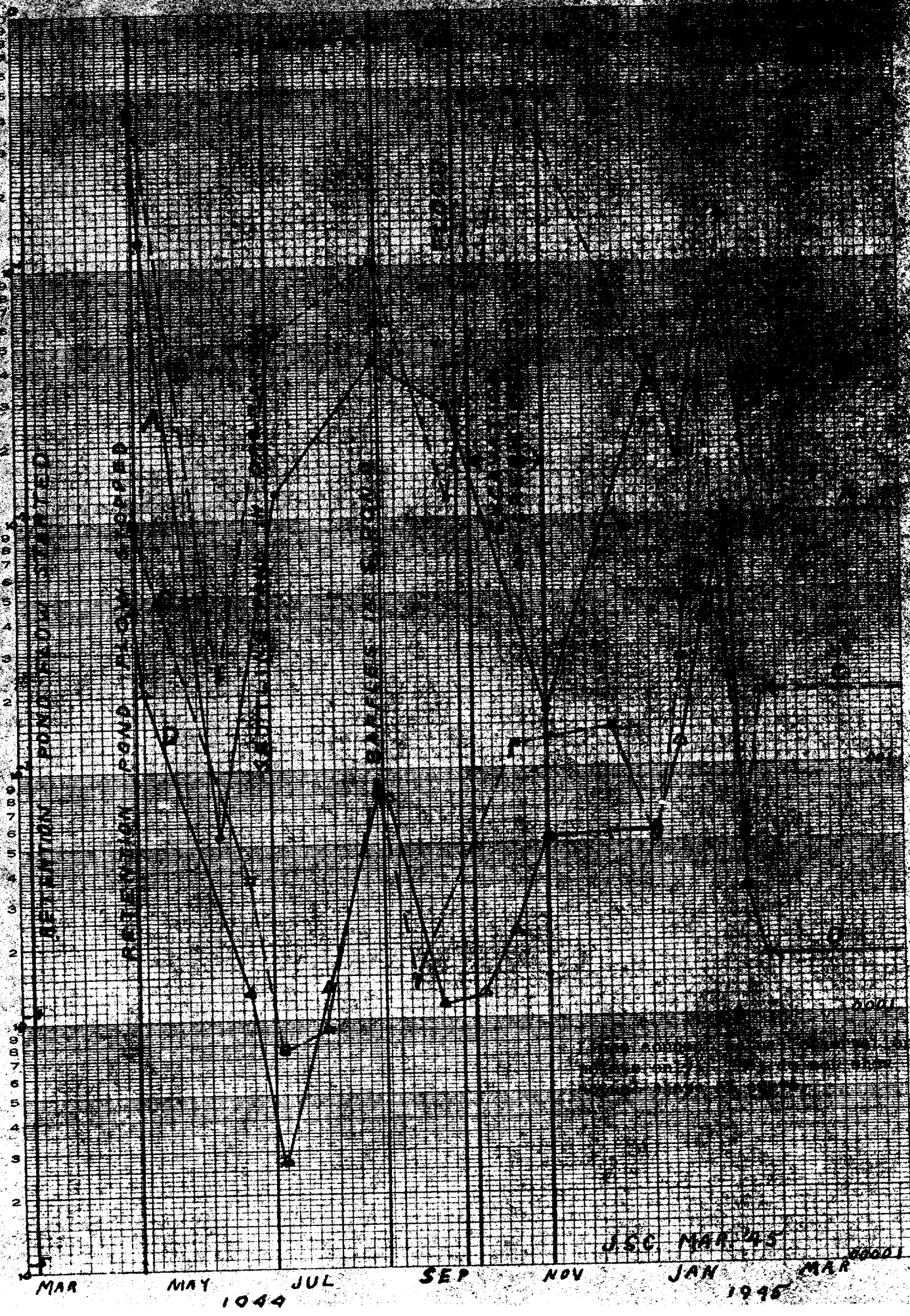
Increase of activity at A and B in January 1945 was probably due to the very small amount of rain at that time, since both beta and gamma counts on the settling pond effluent show a decrease in rate, after the cessation of operations in 205, early in January. The drop in activity in February when there was three times as much rain seems to support this contention.

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Helium

AVERAGE ACTIVITY IN



High readings of C on January 25th and February 23rd were due to sampling at low lake levels, when the mud farther from the original shores was reached.

On January 13, 1945 mud core samples were taken from the bottom of White Oak Lake. These varied from 2 to 12 inches in depth. After drying, the samples were taken from different parts of the cores. Surface samples from the lake floor showed about 5 times the activity of samples at the shore. A separate and more complete report on mud data will be made in April.

V. Atmospheric Radiation (J. S. Cheka et al)

Field surveys by X-22 chambers have shown a drop in atmospheric radiation. Total radiation dropped from 3.51 mr/mo/sta. to 2.65 mr/mo/sta. This is almost directly proportional to the decrease in pile activity, the indices being 2.20 in January and 1.57 in February.

It was further noted that chamber backgrounds have dropped to the figure of last July (having been higher from September through December). This seems to indicate that it was the background of the area rather than of the chambers that had risen, and that this has now fallen to last summer's level.

VI. Effect of the Kind of Collector Lining on Precipitron Collection Efficiency (R. H. Firminhac)

Work done by Cpl. G. Koval indicates that lining the precipitron with aluminum foil increases the amount of product and natural alpha emitters, (radon and thoron products) collected.

On two days when moderately high product concentrations were found in one of the chemistry laboratories, several runs were made with two precipitrons running side by side at the same rate and length of time. One was lined with the usual paper liner and one with aluminum foil 1 mil thick. The runs were repeated without moving the precipitrons, but reversing the liners, paper for aluminum and vice versa. The results indicate a collection factor of ~ 2.5 in favor of the aluminum for natural background and ~ 1.5 for product. The results are summarized in the following table.

| Sample No. | Liner | Background Count | Product Count | Time | Background Count Ratio | Product Count Ratio |
|------------|-------|------------------|---------------|-------|------------------------|---------------------|
| 12-1 | Al | 968 | 112 | 10:30 | 2.3 | 1.7 |
| 12-2 | Paper | 430 | 66 | 10:33 | | |
| 12-4 | Al | 1073 | 80 | 11:04 | | |
| 12-3 | Paper | 468 | 40 | 11:02 | 2.3 | 2 |
| 12-7 | Al | 558 | 386 | 2:57 | | |
| 12-6 | Paper | 230 | 290 | 2:57 | 2.5 | 1.3 |
| 12-8 | Al | 390 | 354 | 3:30 | | |
| 12-9 | Paper | 154 | 254 | 3:30 | 2.6 | 1.4 |
| 13-7 | Al | 430 | 80 | 2:50 | | |
| 13-8 | Paper | 178 | 74 | 2:50 | 2.4 | 1.1 |
| 13-9 | Al | 370 | 62 | 3:25 | | |
| 13-10 | Paper | 150 | 50 | 3:25 | 2.5 | 1.2 |
| Average | | | | | 2.5 | 1.5 |

The reason for the larger ratio of natural emitter collected on aluminum to that of product on aluminum is not clear at present. In another series of experiments fifty-eight samples of natural alpha emitters were collected on aluminum and sixty-one on paper over a period of several days. The averages on each kind of liner were taken and these also gave a factor of 2.5 in favor of aluminum.

VII. The Use of the Balanced Tube Circuit with the Hydrogen Pressure Chamber (H. P. Gauvin and R.H. Firminhac)

The pressure hydrogen chamber for neutron-gamma measurements was rebuilt so that it could be used as a probe. The circuit used is a balanced pair of Victoreen triodes (similar to the circuit used in the "fish pole meters") with accompanying parts mounted in a 4" x 4" x 1" box next to the H₂ chamber. The probe (consisting of the circuit and H₂ chamber) is connected to a battery box by a cable. The batteries are carried in a box about 6" x 6" x 6" slung from a shoulder strap. The meter is mounted on the battery box.

The instrument shows good stability, low rate of drift, and is quite insensitive to most of the usual disturbances. It shows some sensitivity to a charged rod.

With 130 lbs/in² H₂ in the chamber, a 10¹¹ ohm input resistor and 300 v on the chamber, the full scale sensitivity to gamma radiation is 60 mr/hr.

Three resistances are connected in series on a selector switch, giving a useful range of ~ 3 mr/hr to 5 r/hr with sufficient overlapping of the three scales to cover the full range, adequately. The instrument is being calibrated for neutrons.

VII. Work Area Surveys - (W.H. Ray)

The past month has witnessed a more than usual amount of maintenance work in areas of known product contamination. This has necessitated the use of assault masks regularly on a number of operations. The product Room 54 in the Chemistry Bldg. (706A) has been remodeled. This included moving of some hoods and changing of duct work in the attic as especially tricky procedures. The highest precipitron reading during this operation was 2000% of tolerance for product dust in the air.

The product separation Bldg. (204) was cleaned and most of the equipment dismantled for storage. Here the worst condition encountered resulted from the dirt which shook down when the hood ducts were removed from the roof. Waste material plugging the ducts fell back into the room contaminating the area which had been cleaned previously and raising the air contamination to 500% of tolerance for product dust. Both buildings 204 and 205 have been cleaned to a remarkably low level of contamination and have been placed in a stand-by condition.

Maintenance has finally equipped and gotten into operation a "clean-up room" to handle tools, coveralls, and personnel contamination checking. Health instruments provided include a 4-fold hand counter, a pig and probe counter with automatic timer and loud speaker, an electroscope and a pluto (to be replaced with a poppy when one is available). This "clean-up-room" is operated by Mr. Ralph Williams of the Maintenance Department who was trained for this assignment by the Health-Physics Section for a two week period.

Perverse attitudes toward Health-Physics functions in the plant have been disclosed at times. On one instance a spill in the Chemistry building (705A) was concealed from the Health-Physics Section until clean-up could be effected. The surveyor on a routine check was dissuaded from entering this area rather than being sought for assistance.

Exposed sources were found during the month in 706A and in the Hot Laboratory Bldg. (706C).

Precipitron collections were made while tuballoy rods were being removed from a lattice work in a tank on top of the pile. The highest reading was 250% of tolerance. The rods were greased to reduce the dust and masks were worn when the activity in the dust became excessive.

CLINTON LABORATORIES

III. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief.

1. Development and Measurement of New Sources (BX8-3) - J. R. Raper, K.K. Barnes

Measurements are now complete on the intensity of beta rays as a function of the depth in tissue. In this work three emitters were used, P^{32} , Sr^{89} and Y^{91} , and the sources were prepared in three different ways: (1) as thick sources with the material uniformly distributed though a thick plastic plate; (2) thin sources with the material adsorbed on thin pieces of filter paper, and (3) the same thin sources backed with lucite. Measurements were made with an ionization chamber and cellulose acetate was used as the absorbing material.

When the intensity is plotted as a function of depth, the curves are very nearly straight lines on the semi-log plot, but closer inspection shows that they are composed of 2 or 3 straight segments. All 9 sources give absorption curves which are surprisingly alike. The half value thicknesses for each source is given in Table 1.

TABLE 1.

Half-value thicknesses, in mgm/cm^2 , for different types of beta ray sources.

| Isotope | Type of Source | | |
|-----------|----------------|-------------|-------|
| | Thin | Thin-Backed | Thick |
| P^{32} | 88 | 73 | 80 |
| Sr^{89} | 65 | 56 | 60 |
| Y^{91} | 68 | 58 | 66 |

The curves from which these values were taken are not true exponentials, so these values cannot be used to reproduce the original curves.

2. Comparative Studies on Acute Effects of Beta Rays (BX12-1) - J. R. Raper

A number of animals have been exposed but no results are available.

3. Effects of Small Periodic Doses of External Beta Rays on Rats (BX12-2):
K. K. Barnes, J. R. Raper

An accident in the animal farm resulted in the death of all but 4 of the mice receiving 500 r of beta rays per day. These mice have now accumulated a dose of 45,500 r; and it can be said that there have been no deaths due to radiation.

The apparatus for daily exposures of rats to low doses (0.5 - 50 r) of beta rays is now nearly complete. It consists of a tunnel, the central portion of which can be lined with beta ray sources, through which the rats are transported by means of an endless belt. The dose depends on the rate at which the animals are conveyed through the tunnel, so the drive mechanism has been made variable over a wide range of speeds. In this way large numbers of rats can be exposed daily, and for that reason the apparatus has been called a 'rat race'.

4. Effect of Single Doses of Beta Rays to Restricted Area of Rabbits (BX12-3): J. R. Raper, R. S. Snider

Sources are being activated for a complete biopsy series, and exposures should begin next month. The Chicago histology group has completed a preliminary histological study of the rabbits receiving high doses of beta rays to small areas of the back. Biopsy samples were taken from different parts of the burned areas at different times after the exposure, as well as adjacent normal skin biopsies. The picture is quite similar to that from heat burns except that the timing is quite different. Aside from a slight oedema there is very little change in the histological picture up to about 10 days. At this time dead cells are in evidence, and they become increasingly prominent until about 20 to 30 days at which time most of the cells of the germinal epithelium are dead and sloughing occurs, leaving very poorly organized connective tissue covered by a crust of apparently sterile plasma in various stages of dryness. On heavy exposures all of the germinal epithelium, together with the hair follicles are destroyed. In this case, regeneration of the germinal layer must take place from the edges of the ulcer inward. But the connective tissue of the derma is still present but in very poor condition, and it must undergo repair, with re-growth of blood vessels. This repair, however, is much slower than the re-growth of germinal epithelium. The result then is that the germinal layer grows out from the edges over the unrepaired connective tissue which is unable to support it both physically and nutritionally, so the epithelium sloughs off again leaving another ulcer. This process of re-growth and sloughing continues until the connective tissue has repaired enough to support the epithelium, at which time permanent healing takes place. At this time the germinal epithelium re-grows so rapidly that this layer may be as much as ten times its original thickness. In the badly burned areas hair follicles never re-generate.

In areas which did not receive as high an exposure, the epithelium may be destroyed but the deeper hair follicles escape destruction. These follicles cannot only regenerate new hairs but can form new epithelium. In this case there will be islands of epithelium which may undergo sloughing one or more times before final healing. In this case only the deeper hair follicles will escape destruction, and these are the ones responsible for the larger, longer hairs. Thus the hair is sparse and coarse in such a healed area.

It is thus the repair of the connective tissue of the derma which determines the rate of healing of these burns.

5. Recovery of Laboratory Animals From External
Beta Ray Damage (BX12-4): J. R. Raper, K. K. Barnes

All animals have been exposed but it is too early to predict results.

6. Additivity of Gamma and Beta Ray Effects (BX12-5): J. R. Raper, K. K. Barnes

A number of animals have been exposed but it is too early to predict results.

7. Force Feeding of Rats Following Irradiation (BX12-6): E. Anderson

No work has yet started on this problem.

8. Effect of Age on the Radiosensitivity of Animals (BX12-7): R.E.Zirkle

All of the animals have been started on the problem, but there have been no results as yet.

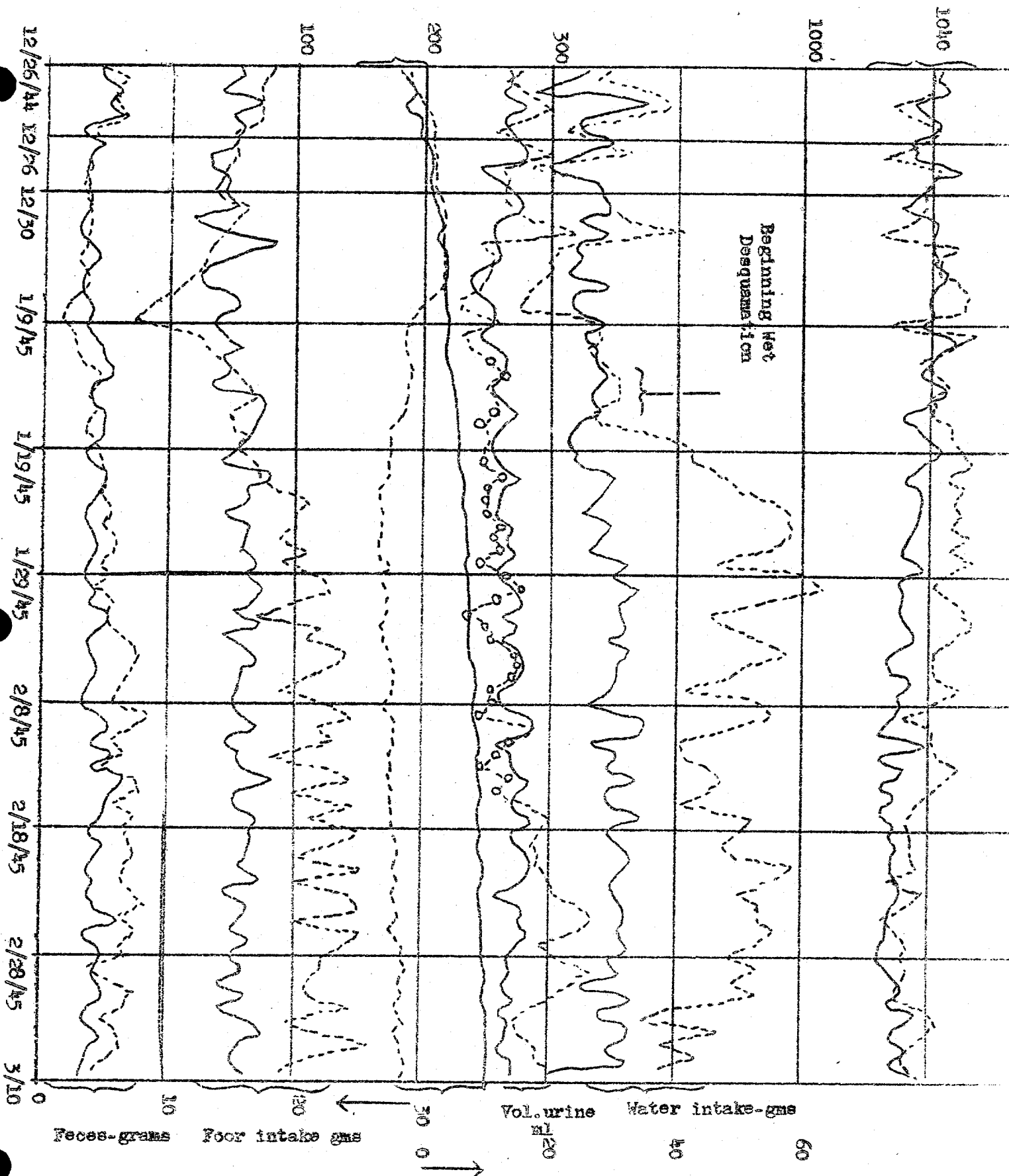
9. Metabolism Following Irradiation: (BX12-8): E. Anderson, K. K. Barnes

A series of twelve rats were started 12/19/44 on this experiment. After a week's control period three were subject to 5000 r; three to 7500 r; 3 to 10,000 r of total body beta radiation and three were kept for controls. The following measurements were made daily: (1) urine specific gravity; (2) water intake; (3) urine volume; (4) weight; (5) food intake; (6) weight of feces; (7) urine albumin. Most of the exposed animals showed changes in all of these quantities, and the magnitude of the effect was roughly proportional to the dose.

The results obtained on the rats receiving 7500 r (the LD50 dose) have been averaged for the three animals and the averages, along with the averages from the controls, have been plotted in Figure 1. The experimental animals are plotted as dotted lines and the controls as solid lines, while the presence of albumin is indicated by a circle on the urine volume curve. Albumin is indicated only if it occurred in all the rats on the same day.

Specific gravity -
Urine

Weight-grams



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The most striking change was that in the water intake, which began about 20 days after exposure and is still high after nearly 3 months. Its onset coincided with the beginning of wet desquamation, which occurred over a large fraction of the body surface. This increase in water consumption was not accompanied by an increase in urine output, which means that these animals must have been losing large quantities of water through the skin.

Albumin appears in the urine somewhat before this period of wet desquamation, which indicates, as did the histological study, that the period of cellular breakdown precedes this. The presence of albumin is an indication of kidney damage, but the damage cannot be very severe since there was never very much albumin present and recovery was fairly rapid. This cellular breakdown is also indicated by the urine specific gravity, which shows that the rats at 7500 r excreted about 15% more solids in the urine than normal, in spite of the fact that the weight was falling. Even after nearly 3 months the total urine solids are still high because the specific gravity is normal but the volume has now increased. The food and water intake are still quite high, in spite of the fact that these animals are now nearly healed and are partially covered with hair.

There is apparently a gastro-intestinal upset starting about 10 days after exposure as evidenced by decreased food and water consumption followed by a loss of weight. Both food and water intake soon start to rise and exceed the controls, but the weight continues to fall. This must indicate that for a long period intestinal function is impaired. Even now the food and water consumption is much higher than normal, but the weight gain has only recently risen to the normal value. That the extra food is not absorbed from the intestine is shown by the fact that the feces have increased correspondingly.

These animals will be followed carefully until they return to normal or until a permanent metabolic picture is established.

10. Water Metabolism Following Irradiation (BX12-9): E. Anderson

No work has been started on this problem.

11. Biological Monitoring (BX12-10): E. Anderson

No new developments have taken place on this problem.

12. Effect of Periodic Doses of Slow Neutrons on Mice (BX12-11):

P. S. Henshaw, E. F. Riley, G. E. Stapleton.

The starting of this series has been further delayed, but it should certainly start within the next month.

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13. Biological Effects of Single Doses of Slow Neutrons on Mice (BX12-12): P. S. Henshaw, E. F. Riley, G. E. Stapleton

A small pilot series of mice was started on this problem last August, and is beginning to show results. More animals will be started soon.

14. Effects of Small Periodic Doses of Gamma Rays on Mice (BX12-13): P. S. Henshaw, E. F. Riley, G. E. Stapleton

Animals in this group are beginning to show the effects of treatment, but it is too early to make any statements on them.

15. Delayed Effects of Single Gamma Ray Doses on Mice (BX12-14):
P. S. Henshaw, E. F. Riley, G. E. Stapleton.

16. Delayed Effects of Single Doses of Fast Neutrons on Mice (BX12-15): P. S. Henshaw, E. F. Riley, G. E. Stapleton

Treatments were completed in October 1944 and no significant results have been obtained as yet.

17. The Absorption of Strontium (BX12-16): H. J. Curtis

Four rats have been fed equal tracer quantities of Sr^{89} in the drinking water. For two of the animals the strontium was in pure solution, while for the other two the strontium was adsorbed on clay particles. After 4 days the animals were sacrificed and the femurs analyzed for Sr^{89} . The results are expressed in Table 2 as percentages of the administered dose. It will be seen from the table that the material had almost completely left the gut. It will also be noted that absorption is nearly as great, if not as great, whether the material was adsorbed in clay or not. There is some indication that there may be a difference but these results are not accurate enough to warrant drawing such a conclusion. More accurate results will be available soon.

TABLE 2.

Percentages of Sr^{89} deposited in the skeleton as determined from measurements on right and left femurs, assuming the skeleton comprises 15% of the body weight. The amount left in the G.I. tract is given as a percentage of the administered dose.

| | <u>Left femur</u> | <u>Right femur</u> | <u>G.I. tract</u> |
|---------------------------|-------------------|--------------------|-------------------|
| 53000 Sr in solution | 14.6 | 13.5 | 0.11 |
| 53001 " " " | 14.1 | 12.5 | 0.06 |
| 53002 Sr adsorbed on clay | 12.0 | 10.7 | 0.07 |
| 53003 " " " " | 9.3 | 9.1 | 0.05 |

18. Effect of Small Periodic Doses of Fast Neutrons on Mice (BX12-17): P. S. Henshaw, E. F. Riley, G. E. Stapleton

Many of the lots of mice in the series at 1.15 n per day have now been treated for 7 to 8 months and mortality is nearly complete. Generally the animals show atrophy and death may occur with no apparent cause other than extreme atrophy. However, a large number of the animals die of cancer (usually mediastinal lymphomatosis). A complete account of this experiment will be rendered when more of the pathological and haematological material has been examined.

19. Delayed Effects of Single Doses of External Beta Rays (BX12-18): J. R. Raper

This problem is progressing satisfactorily and will be reported next month.

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W. T. Bray

For: H. T. Bray, Supervisor
Laboratory Records Dept.

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HEALTH DIVISION

and

BIOLOGICAL SECTION OF THE RESEARCH DIVISION

REPORT FOR MONTH ENDING APRIL 15, 1945

J. E. Wirth, M.D. - K. Z. Morgan
and H. J. Curtis

Series A Received: 4/19/45
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ABSTRACTS

I. Medical Section of Health Division

None.

II. Health-Physics Section of Health Division

An examination of the personnel monitoring meter readings of persons engaged in "hot" operations during the past five "hot runs" in Bldg. 706-C indicates considerable radiation exposures but none of serious consequence. The average badge meter readings are lower than the average pocket meter readings.

It was necessary to establish a full time Health-Physics representative in the new La Separation Building (706-D) before the building construction was completed because of fumes, contamination and direct radiation from the adjacent Hot Lab. (706-C)

Some of the frothing liquid from the 706-C neutralizing tank was drawn into the off-gas line connecting the 205 stack. The radiation near the off-gas line reached 1000 mr/hr.

The use of the X-22 chambers has been discontinued.

The new Neon-ether GM tubes are superior to others tested from the standpoint of thermal sensitivity.

Area surveys and soundings are being made in the White Oak Creek and Lake drainage system in order to estimate the curies retained in the mud. The long-lived rare earths seem to predominate in the mud activity.

A slow neutron counter is being used with Poppy.

Experiments are under way in an effort to develop a satisfactory way of determining the amount of product in a wound.

The decontamination Laundry has changed over completely to the citric acid process, which continues to prove far superior to the old acetic acid process.

III. Biological Section of Research Division

An analysis has been made of the lethal action of slow neutrons on mice. It has been found that an exposure in the West biological tunnel for 1.7×10^4 kw-hr of operation will produce death in half the mice. There is a fast neutron contamination in the tunnel which is responsible for

It has been found that following a single exposure of mice to beta rays, recovery is half complete in about 3 days, and after about 10 days the animals start to show a greater than normal resistance to beta ray exposure. This result explains the high resistance to periodic exposure to beta rays previously reported for mice.

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CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

Report by J. E. Wirth, M. D.
Medical Director

1. Medical Activities

- (a) Dispensary service continued on a 24-hour basis.
- (b) The personal illness rate has been about one-third as high during the present month as it was during the previous two months. An early, warm spring brought the change.
- (c) In an attempt to verify threshold skin reaction to pure Beta rays, the volar aspect of the left forearm of 11 individuals were tested with a 2.5 cm (diam) round plaque consisting of bakelite impregnated with P^{32} . The surface of the bakelite was covered with a thin layer of varnish to prevent contamination of the skin with P^{32} . Light pressure, surface contact, exposures were given over 4 areas extending from the antecubital region downward toward the wrist in amounts of 140, 170, 200 and 250 r respectively, (as measured at the surface of the plaque and skin) with a clear zone of at least 1 cm distance between each exposure. The areas were observed daily for a week, 3 times per week for a week, twice a week for 3 weeks, and then at weekly intervals.

A preliminary summary at the end of five weeks indicates that the threshold reaction in 80% of the individuals is between 170 and 200 r. It is probably just above 170 r. Eight of 10 with 200 and 250 r showed positive reaction, while only 5 to 6 of 10 showed positive reaction to 170 r between the second and fifth weeks. It is quite notable that the reaction cannot be spoken of as a threshold erythema, as it appears more in the form of a mild tanning with only 2 or 3 of the 10 persons showing any pinkness or redness.

2. Clinical Laboratory

- (a) Routine blood counts and urinalysis are being continued on a constant level.
- (b) An increased number of stippled red blood cells has again been noted. The comment was made previously in monthly reports that the number of stippled cells found seemed to be in proportion to the amount of time spent looking for them. It is now believed that such a statement must be modified as this last increase in number bears no

relation to the amount of time spent looking for them. The first time an increased number was noted was at this time of the year, one year ago.

3. Special Hazards

- (a) X-22 Chambers for Monitoring Atmospheric Radiation. The use of the X-22 chambers was discontinued on March 31st. The length of time they had been in service has given a fair idea of the variations above background which could be used for a comparative basis in case of an accident at the plant, or in case of any marked change in the type of operation of the plant. The remaining Integrators, the continuous recording GM counter (across the road from the 100 and 200 Area stacks) and other monitoring devices on the plant should be sufficient for the present and future contemplated operation of the plant.
- (b) Survey Instruments. The problem of the development or improvement and provision in adequate numbers of one or two good instruments for beta-gamma surveys still exists.
- (c) Decontamination Laundry. The use of sodium citrate instead of acetic acid in the decontamination laundry has proved very successful.

4. Personnel.

Dr. Charles S. Gelbert was added to the Medical Staff on April 6, 1945.

Medical technicians are still scarce.

CLINTON LABORATORIESII. HEALTH-PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

1. Hot Run Radiation Exposures

The Lanthanum preparations in the Hot Laboratory (706-C) have presented some of the most difficult problems at Clinton Laboratory from the standpoint of personnel radiation exposures. The newness of the problem and the urgency for production were expected initially to make this operation rather hazardous. However, from the very start of this operation the production demands have exceeded the facilities of the Hot Laboratory. Now production is about twenty times the level for which the building was designed and the radiation problems have increased correspondingly. There have been some apparatus difficulties and errors which have lead to minor radiation exposure, but due to the continued cooperation and untiring efforts of the Hot Laboratory personnel, no serious exposures are thought to have occurred. Seven hot runs have been completed and preparations are now underway to begin the last run in this building in a few weeks. Table I is enclosed to indicate the magnitude of the radiation exposures during the past five runs and to confirm the fact that no serious exposures have resulted during this period. Runs four plus five and six plus seven were double runs and are treated as single runs. Runs three, four plus five, and six plus seven extended over the periods 11/16 - 11/25, 1/17 - 2/3 and 3/20 - 4/4 respectively. This table includes the exposure records of all persons who worked at any time in the Hot Laboratory during each of the last five hot runs. The numbers in the table give the total mr exposure as measured by the indicated meters during runs three, four plus five, and six plus seven. The finger meters were worn at irregular intervals, and therefore cannot be compared with the readings of the other meters. The blanks indicate when finger meters were not worn at all during a run. The pocket meters and badge meters were always worn simultaneously though not at the same location on the body. In general the pocket meters read higher than the badge meters. This is probably due to successive discharges of the pocket meters due to rough treatment and to the accumulated leakage of the meters. Some persons on other projects have expressed a lack of confidence in the badge meters due to their energy dependence. However, a close examination of the daily records during the hot runs does not give any evidence that the energy dependence of the pocket meters is of serious consequence. The different meters were not worn on the same part of the body in general and the geometry factor is believed to be responsible for most of the discrepancies in the readings. During the next hot run seven special film meters in addition to the regular meters will be worn by all of the 706-C personnel. These film meters will be worn on various

parts of the body and it is hoped that the data will give more definite information concerning the average distribution of a radiation exposure over the body. It is perhaps of some interest to note that the ratios of the average pocket meter readings to the badge meter readings for runs three, four plus five and six plus seven were 1.90, 1.50 and 1.56 respectively.

A comparison of the meter readings in Table II with those in Table I seems to indicate that the higher pocket meter readings cannot be accounted for completely on the basis of rough treatment to the pocket meters.

TABLE I.

METER READINGS OF PERSONS WORKING IN 706-C DURING HOT RUNS

| Person | Pocket Meter Exposures | | | Finger Meter Exposures | | | Badge Meter Exposures | | |
|---------|------------------------|---------|---------|------------------------|---------|---------|-----------------------|---------|---------|
| | Run 3 | Run 4+5 | Run 6+7 | Run 3 | Run 4+5 | Run 6+7 | Run 3 | Run 4+5 | Run 6+7 |
| B, D.S. | 180 | 450 | 675 | - | 435 | - | 60 | 170 | 310 |
| B, R. | 590 | 605 | 645 | - | 325 | - | 140 | 305 | 195 |
| B, S. | 145 | 430 | 355 | - | - | - | 135 | 90 | 170 |
| B, E.L. | 180 | 565 | 425 | 150 | 1520 | 475 | 250 | 675 | 460 |
| C, C.D. | 90 | 280 | 190 | - | - | - | 75 | 295 | 95 |
| G, L. | 245 | 290 | 245 | - | - | 115 | 75 | 135 | 150 |
| G, R.E. | 600 | 585 | 600 | 330 | - | 400 | 475 | 105 | 260 |
| G, M.J. | 355 | 495 | 885 | - | 155 | 360 | 80 | 300 | 355 |
| H, D.H. | 545 | 825 | 575 | - | - | 130 | 245 | 575 | 260 |
| H, M.H. | 395 | 535 | 565 | - | - | 300 | 145 | 220 | 240 |
| L, F.R. | 250 | 470 | 405 | - | - | 350 | 120 | 495 | 620 |
| L, H.A. | 565 | 300 | 315 | 390 | - | 280 | 310 | 310 | 265 |
| M, G.E. | 110 | 245 | 135 | - | - | - | 75 | 25 | 100 |
| M, R.K. | 105 | 80 | 210 | - | - | 580 | 100 | 70 | 160 |
| N, E.L. | 760 | 515 | 265 | - | - | 70 | 665 | 510 | 90 |
| P, C.W. | 250 | 455 | 375 | 150 | - | - | 140 | 110 | 305 |
| P, E.R. | 630 | 495 | 545 | - | 670 | 130 | 360 | 1265 | 505 |
| R, D.M. | 235 | 185 | 115 | - | - | - | 80 | 105 | 30 |
| R, A.M. | 435 | 335 | 340 | 3495 | 665 | 1165 | 425 | 410 | 240 |
| S, C.B. | 100 | 190 | 200 | - | - | - | 15 | 15 | 30 |
| S, G. | 510 | 205 | 425 | 70 | - | 120 | 295 | 285 | 335 |
| T, E.R. | 105 | 330 | 250 | - | - | - | 30 | 30 | 90 |
| V, C.R. | 170 | 355 | 310 | - | - | 40 | 150 | 270 | 275 |
| V, C.D. | 160 | 230 | 175 | - | - | 45 | 60 | 35 | 185 |
| W, S. | 260 | 405 | 540 | - | 305 | 190 | 100 | 185 | 475 |
| Y, E.J. | 345 | 740 | 375 | - | 530 | 160 | 210 | 340 | 240 |
| Z, H. | 410 | 530 | 515 | 405 | - | 330 | 240 | 535 | 395 |
| Average | 355 | 412 | 395 | 713 | 576 | 308 | 187 | 276 | 253 |

TABLE II.

METER READINGS OF CONTROLS IN THE PLANT DURING
THE SAME PERIODS COVERED IN TABLE I

| Person | Pocket Meter Exposures | | | Badge Meter Exposures | | |
|---------|------------------------|-------------------|-------------------|-----------------------|-------------------|-------------------|
| | 11/16 to 11/25 | 1/17 to 2/3 | 3/20 to 4/4 | 11/16 to 11/25 | 1/17 to 2/3 | 3/20 to 4/4 |
| C, E.T. | 50 | 55 | 110 | 0 | 0 | 0 |
| C, M.W. | 50 | 65 | 95 | 0 | 0 | 0 |
| F, S.F. | 25 | 15 | 50 | 0 | 0 | 0 |
| H, R. | 15 | 65 | 65 | 0 | 0 | 0 |
| K, P.J. | 60 | 95 | 125 | 0 | 0 | 0 |
| M, J.C. | 50 | 75 | 95 | 0 | 0 | 0 |
| M, W. | 25 | 55 | 85 | 0 | 0 | 0 |
| R, G.C. | 50 | 40 | 90 | 0 | 0 | 0 |
| W, V. | 15 | 70 | 75 | 0 | 0 | 0 |
| W, A.D. | 20 | 55 | 30 | 0 | 0 | 0 |
| Average | 36 | 59 | 83 | 0 | 0 | 0 |

2. Work Area Survey - W. H. Ray et al

More than 24 reports have been observed, during the past month of spots in hoods, sinks, and on benches in the Chemistry Building (exclusive of semi-works) which gave readings 13 mr/hr. In most cases the interposition of a 1/2 inch thick wood screen has cut the reading to about 1/4 the open window value.

Although these values have been measured at about 3 inches from the source, more than contamination possibilities are implied when such findings are recorded repeatedly in successive weekly reports.

A double run (six plus seven) was completed this month in the Hot Lab. (706-C) with the usual contamination difficulties. Radiation from the vent duct of Bank 2, although shielded with lead sheet, has been found to contribute about 1/2 of the general background. The resulting background was 13 mr/hr on the main floor and 50 mr/hr on the top of Bank 2.

Fumes, contamination, and direct radiation from 706C required the establishment of a full time Health-Physics representative in the new La Separation Building (706-D) before the building construction work was completed. It was necessary to rope off large areas of 706-D which were above the 12.5 mr/hr tolerance level due to radiation from the 706-C Building. Except for work on the roofs, it has not been too difficult to keep conditions in 706-D respectable when 706-C is not in operation

Direct, prompt and complete reporting of routine laboratory surveys has been undertaken by use of survey report diagrams showing the room lay-outs and the findings in symbols that do not require classification. Two days use of the system has yet neither proved a blessing nor a handicap.

Of interest is the activity which appeared in the overhead off-gas line leading from 706-C to the 205 stack. This off-gas line runs underground for about 100 yards after leaving the 706-C Building and then it is suspended about 20 ft. above ground for a distance of ~50 yards to the 205 stack. Readings of 1000 mr/hr were found against the pipe where it rises out of the ground. A reading of 100 mr/hr found on the core room steps, west of Building 105, was traced to radiation from the overhead portion of the pipe. Hence, a large area of the yard near this pipe was roped off until it could be flushed with water. This flushing brought the activity of the riser from 1000 mr/hr down to 19 mr/hr. The 90 mr/8 hrs recorded by the Integrator on top of the pile (Bldg. 105) was believed due primarily to the radiation coming from the off-gas line.

The activity of the off-gas line is believed to have been the result of neutralizing the 706-C underground waste tank when it was too full. This tank is vented to the off-gas line, and some of this frothing liquid could have been carried through the vent and up the hill by the two steam jets on the off-gas line.

A system has been set up by which the 105 supervisors and fire captains will be initially responsible for emergency radiation hazards in the event of a fire in the plant during the night time when a Health-Physics representative is not available. A briefing of health hazards and what to do about them was given to the fire captains and 105 supervisors so that they might more intelligently direct activities in case of emergency until Health-Physics personnel can arrive at the scene. A kit of Health-Physics instruments for the use in such an emergency by the 105 supervisors is being prepared for the firemen to take to fires.

Atmospheric Monitoring. The primary objective of off area monitoring has been to determine that no radiation hazard is developing off the plant due to the off-gases from the pile and from the separation plants. Since the initial objective has been achieved, the monitoring of atmospheric radiation with the X-22 "kangaroo" chambers was discontinued April 1, 1945, to make man power available for other more urgent work in the Health-Physics Section. A summary report of the findings is in preparation by J.S.Cheka.

3. Thermal Sensitivity Tests of the Neon-Ether GM Tubes - W. H. Ray

Four 85% Neon 15% Ether GM tubes developed and constructed by D.R. Luster (CP-2594) have been tested for temperature sensitivity from 25°F to 120° F. Plateaux run at both of these extremes seem to be about equally flat

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(for a change of 100 volts in counter potential when counting at a rate of 2000 c/m, 10 c/m change was observed). At the lower temperature the left "knee" of the curve tends to encroach upon the flat portion but not beyond 1/3 of the way between threshold and breakdown potential.

The plateaux were about the same length at both temperature extremes (220 volts or more). However, the curve at the lower temperature is displaced about 20 volts to the right of the other. This is in agreement with the findings reported in CP-2594.

Keeping identical geometry and maintaining the counter voltages within the upper two thirds of the plateau, the counting rate (approximately 2000 c/m for all tests) was identical at both temperature extremes.

To simulate field operating conditions each tube was operated respectively at 1/3, 1/2 and 2/3 the voltage from the lower to upper limit of the plateau as indicated by the card supplied by the instrument shop with each tube. At each of these voltages the time required to count 5000 counts at a rate of 2000 c/m was recorded every 3 minutes as the temperature of the tubes was changed from 25° F to 120° F at a rate which consumed about 5 hours for the transition. Only statistical deviations of counting time were observed at the 1/2 and 2/3 voltages. Slight drift of the counting time was found occasionally when operating at the 1/3 voltage, but was not >5%. This might be expected if the lower knee changes shape with temperature. All the voltage changes and recordings of counting rates and temperatures were made by the use of an automatic plateau testing machine developed by the 717-B Instrument Group (See report of D.R. Luster of April 20, 1945)

It would seem from the above that the 85% Neon 15% Ether mixture should be adopted for all our Health-Physics GM tubes since it is far superior to other tubes that we have tested.

One tube was found to be photo-sensitive.

4. Summary of Mud Surveys - J. S. Cheka and L. H. Weeks.

On 3/9/45 a survey was made of mud activity in the White Oak drainage system from the outlet of the settling basin to the Clinch River a few hundred yards below the mouth of White Oak Creek. The total distance covered along the stream was about three miles. There was a decrease of activity noted from $1.1 \times 10^{-2} \mu\text{c/gm}$ of mud average in several points of the creek just below the settling basin to zero for all points checked in the Clinch River. This decrease, however, occurred only where flow was uninterrupted. The highest activity occurred in a small shallow pond about 1.2 acres in area, which is located a mile below the settling basin. The activity here was $3.5 \times 10^{-2} \mu\text{c/gm}$ of mud. It was also noted that

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the average of several samples taken from the mud flats at the head of White Oak Lake (now at low level) showed $1.6 \times 10^{-2} \mu\text{c/gm}$.

The above observations indicate that the White Oak Creek water system is effective in preventing any appreciable contamination of the Clinch River bed by fission products and also that the major deposits of active material occur in the intermediate ponds, and at the head of White Oak Lake.

A project was started this past month to collect and summarize the data of the Drainage System of Clinton Laboratories. One of the first assignments on the project was to estimate the total curie content of the above drainage system. The intermediate pond, White Oak Lake, the mud flats below White Oak Dam, and the marshy section above the intermediate pond are being surveyed and carefully mapped.

To determine the total mud activity, core samples of mud are being taken to several inches in depth from various parts of the mud flats and lake bottom. It was found that in the intermediate pond there is no activity deeper than six inches. White Oak Lake samples showed no activity below four inches except in the channel.

The next phase of this project consists of taking core samples over an area so distributed as to give a representative average value. Each of these core samples is mixed to a uniform consistency, then small samples are taken from this to be dried and counted in a beta-chamber in the routine manner. The $\mu\text{c/gm}$ of mud are calculated, and after the dry weight of the core has been obtained, $\mu\text{c/core}$ are determined. From this value, the activity of a given area can be determined.

This procedure has been followed for the intermediate pond. The average activity found here was $1.91 \mu\text{c/core}$, giving 4.6 curies as the estimated total for the 1.2 acres.

Similar work was started at the southwest corner of White Oak Lake. About an acre of White Oak Lake has been sampled so far. The average value found was $0.16 \mu\text{c/core}$. It is too early to make an estimate of lake bottom activity, since the sampled area is not sufficiently extensive and representative of the whole lake.

A preliminary analysis of the mud as indicated below seems to indicate a predominance of Ce and other rare earths.

Chemical Analysis by D.M. Black

| Sample | Re β (chiefly Ce) | Sr β | Zr β | Cb β | Ru β | $\Sigma \beta$ | Gross |
|--------|-------------------------|------------|------------|------------|------------|----------------|-------|
| 2 | 60 c/m/ml | 6 | 9 | 7 | 14 | 96 | 98 |
| A | 34 | 5 | 13 | 7 | 9 | 68 | 65 |
| 1B | 116 | 2 | 15 | 3 | 23 | 159 | 297 |
| 4B | 155 | 2 | 18 | 12 | 30 | 217 | 231 |

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5. Instrument Development - R. H. Firminhac

Poppy. None of the 22 Poppies on the project order has been delivered, but a few built on separate orders as preliminary models have given good service for several months and are extremely useful where they are available. A much needed addition has been made to this instrument by Borkowski's group in the form of a probe sensitive to thermal neutrons. It consists of a boron lined steel cylinder about 1-1/2" in diameter and 8" long filled with an atmospheric of methane. A one mil tungsten wire is the collecting electrode. It operates as a proportional counter at about 2100 V, and shows no sensitivity to γ 's at this voltage. The exact sensitivity to thermal neutrons has not been determined, but it is much more sensitive than the boron lined Lauritsen electrosopes presently used for thermal neutron measurements.

Several of the new Victoreen low current drain rectifier tubes have been received, and if they hold up to their rated voltage, they should simplify the high voltage problem and make a very light, portable, walkie Poppy possible.

Product in Wounds. Work has been started on the detection of product in wounds by the measurement of neutrons from the fission of product when exposed to thermal neutrons. Measurements of the neutron flux in the thermal column at the back of the pile showed fluxes of 1.7×10^4 n cm⁻² sec⁻¹ at the hole farthest from the pile when operating at a power level of 4 M.W. The flux in the hole nearest the pile is 1.7×10^6 at 3 M.W. The maximum flux available will probably be less than 3×10^6 n cm⁻² sec⁻¹ which is considerably below that desired, namely 10^9 n cm⁻² sec⁻¹. It is not known at present if this desired flux can be obtained in any apparatus presently available and suitable to the operation.

Several different methods of measuring both fast and slow neutrons are being studied and some apparatus is being built, for the purpose. However, it is too early to give any final results.

Four-Fold Hand Counters. Improved factors for the GM counters as determined by the counter test (see memo R.R. Coveyou to K.Z. Morgan 1/1/45) were found to correlate with more satisfactory operation of the counters this month. The improvement can be attributed to the much more careful observation of the counter operation by the instrument shop and to correction of several previously unknown faults in the counters. Mr. C. P. Fortner's group will make a separate report on the maintenance of four-fold hand counters when they are satisfied that these inherent faults have been remedied.

Victoreen Survey Meter. A rebuilt and supposedly improved model of the 0-200 mr/hr Victoreen survey meter has been received and is being tested. The calibration is low on the high end of the scale ($\sim 23\%$ at 130 mr/hr) and nearly correct at the lower end (W.O.) (10-20 mr/hr). When the battery voltage was varied from ~ 30 to ~ 42 volts the meter sensitivity varied

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about 15% with a maximum sensitivity at 35 volts. The drift for a 2-1/2 hours period was from 20 mr (set with zero set) to zero. Very shortly thereafter the instrument acted erratic. The battery was found discharged down to 32 v and heating up indicating a serious short circuit. The instrument seemed to be working again the last time it was tried, but the reason for the erratic behavior and high battery drain has not been definitely explained so far.

Remounting of Lauritsen Electroscope. A Lauritsen electroscope has been mounted in a six inch bakelite cylinder, using a variable condenser and one 45 v hearing aid battery for charging. The flashlight cells are accessible from the top of the cylinder, making it unnecessary for anyone except an experienced repair man ever to remove the Lauritsen with the accompanying parts from the case. It should be possible to dip the outside cylinder in acid for decontamination and thus remove this cause of high mortality on Lauritsen cases.

6. Decontamination Laundry - J. E. Bradley et al

On March 19, 1945 the decontamination laundry changed over completely from the acetic to the citric acid process. The results during the past three weeks period have been very encouraging. The number of laundry re-washes has been reduced considerably and it has thereby been possible to decrease the laundry personnel.

The table below gives the story of the laundry rewashes during the past six weeks. The rewash garments are those which give a β count > 500 c/m or an α count > 1500 d/m after being washed.

REWASH CLOTHES IN THE DECONTAMINATION LAUNDRY

| <u>Date</u> | <u>Process</u> | <u>Number of Clothes Rewashed</u> | <u>Number of clothes returned for a 2nd re-wash</u> | <u>% returned for a 2nd re-wash</u> |
|-------------|----------------|---|---|---|
| 2/26 - 3/3 | Acetic | 79 | 26 | 32.9% |
| 3/4 - 3/10 | Acetic | 168 | 81 | 48.2% |
| 3/11 - 3/18 | Acetic | 102 | 41 | 40.2% |
| 3/19 - 3/25 | Citric | 406 | 28 | 6.9% |
| 3/26 - 4/1 | Citric | 32 | 1 | 3.1% |
| 4/2 - 4/8 | Citric | 26 | 0 | 0% |

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CLINTON LABORATORIES

III. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief

1. Development and Measurement of New Sources (BX-8-3) - J. R. Raper, K. K. Barnes

There has been no activity on this assignment during the past month.

2. Comparative Studies on Acute Effects of Beta Rays (BX12-1) - J. R. Raper,
K. K. Barnes.

One day old rats have been exposed to beta rays at doses of 1500 r and 2500 r. It has been found that: (1) the median lethal dose is between these two values, since most of the rats at the higher dose died about 9 days after exposure, while none of the animals receiving 1500 r died; (2) growth has been considerably retarded in all irradiated animals; (3) there was no growth of hair at the high dose, and it was badly retarded at the low dose.

3. Effects of Small Periodic Doses of External Beta Rays on Rats (BX12-2) -
J. R. Raper, K. K. Barnes

Exposures of the mice receiving 500 r per day were discontinued on March 17, 1945. At this time they had accumulated a dose of 47,000 r. None of these animals died as a result of the radiation. They have remained almost completely hairless, and no change in gross appearance of those animals has occurred after about the 5th week of treatment. They remain active and gain as much weight as their controls.

During the month a large series of rats have been started on periodical total surface beta irradiation. The doses range from 0.5 r per day to 50 r per day. The exposures take place in the "rat-race", which has been extensively checked and calibrated during the month.

4. Effect of Single Doses of Beta Rays to Restricted Area of Rabbits (BX12-3) - R. S. Snider, J. R. Raper, K. K. Barnes.

A new series of rabbits has been exposed on this problem to clear up some questions which were raised by the first series, and also to obtain material for a complete histological picture of the breakdown and repair of a beta ray burn as a function of dose and time.

5. Recovery of Laboratory Animals From External Beta Ray Damage (BX12-4) - J. R. Raper, K. K. Barnes

The data are now complete for the shorter intervals of this experiment. A group of mice was exposed to total surface beta radiation at a dose of 3000 r, the median lethal dose of this species being 4700 r. Following this

exposure at various intervals, groups of these mice received various additional doses of total surface beta radiation to determine the median lethal dose for these mice at that time.

TABLE I.

RECOVERY FROM 3000 r TOTAL SURFACE BETA RADIATION
20 gram female mice, strain CF1

| <u>Days Between Exposures</u> | <u>Dose in Second Exposure to Produce Death in 50% of the group</u> | <u>Remaining Effect</u> | <u>% Recovery</u> |
|-------------------------------|---|-------------------------|-------------------|
| 0 | 1700 r | 3000 r | 0 |
| 3 | 3600 r | 1100 r | 63 |
| 7 | 4500 r | 200 r | 93 |
| 14 | 4950 r | -250 r | 108 |
| 28 | 5300 r | -600 r | 120 |

From these values the effect remaining after the initial 3000 r dose can be computed as a function of time, and expressed as remaining damage, in r units, or as per cent recovery. This has been done in Table I. It will be observed that the animals have more than half recovered after only 3 days, and that there is complete recovery after about 10 days. When plotted these points do not fall on an exponential curve, but it is doubtful that the points are accurate enough to be sure of this result. Thereafter the remaining effect goes negative, indicating that this radiation will afford some protection against additional exposures after a period of time. This protection might be simply mechanical shielding of the sensitive tissues by a thickened layer of dead epithelium. If so, it should be revealed by the histological study which is now being made.

These results explain the result obtained in the experiment on the periodic exposure of mice to beta rays, in which mice withstood total surface beta irradiation at a rate of 500 r per day almost indefinitely. They not only recovered quickly from each dose, but built up a certain immunity to the radiation.

6. Additivity of Gamma and Beta Ray Effects (BX12-5) - J. R. Raper, K. K. Barnes

A number of animals have been exposed on this problem but no results are yet available.

7. Force Feeding of Rats Following Irradiation (BX12-6) - E. Anderson

No work has yet started on this assignment.

8. Effect of Age on the Radiosensitivity of Animals (BX12-7) - R. E. Zirkle

No results are yet available on this assignment.

9. Metabolism Following Irradiation (BX12-8) - E. Anderson, K. K. Barnes

Animals on this problem are being followed, but no striking changes have appeared during the month.

10. Water Metabolism Following Irradiation (BX12-9) - E. Anderson

No work has yet been started on this assignment.

11. Biological Monitoring (BX12-10) - E. Anderson

No new developments.

12. Effect of Periodic Doses of Slow Neutrons on Mice (BX12-11) -
P. S. Henshaw, E. F. Riley, G. E. Stapleton

A number of groups have been started on this experiment, and more will be started soon.

13. Biological Effects of Single Doses of Slow Neutrons on Mice (BX12-12) - P. S. Henshaw, E. F. Riley, G. E. Stapleton

The animals that were given single doses (ranging from 134 to 520a) during August and September 1944, continue to show tumors of one kind or another in most of the animals that die. Not enough have died however to permit a significant estimate of incidence. New series are being treated at this time at the 276 and 400 a levels.

14. Analysis of Slow Neutron Effects in Mice (BX12-12) - R. E. Zirkle

The LD50 for CF₁ mice has been found to be 375 arbitrary units, one such unit being one scale division of a Victoreen r-meter whose 100 r chamber was enclosed in a sheath of boron carbide and was therefore discharged by the gamma rays emitted from the Li⁷ formed in the reaction $p^{10} (n, \alpha) Li^7$. One arbitrary unit was obtained with 45.6 kw-hr of operation, the slow neutron flux in the tunnel being 67.5 neutrons/(cm² sec watt).

Fast neutrons were also present, 0.0026 n units being received by the animals per kw-hr. The fast neutron dose received by the mice during an exposure of 375 arbitrary units was therefore $375 \times 45.6 \times 0.0026$ or 44.5 n units. Since the LD50 for fast neutrons alone had previously been found to be 90 n units, it follows that almost exactly one-half of the LD50 of "slow" neutron irradiation was due to fast neutrons.

The remaining half of the lethal action may be ascribed to the slow neutrons. The dose of capture gamma rays received at the center of a mouse, where the intensity was a maximum, is calculated to have been 84 r, and preliminary direct measurements of gamma rays emitted from mice exposed to slow neutrons show that this figure is substantially correct. Since earlier experiments have shown that, for acute lethal action on CF₁ mice, 1 n of fast neutrons is equivalent to 7.5 r of gamma rays, the gamma ray dose of 84 r was therefore equivalent to 11 n of fast neutrons. If this be added to the 44.5 n contributed by

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the fast neutrons themselves, a total lethal action equivalent to 55.5 n is obtained. However, the exposure to 375 arbitrary units (LD50) was lethally equivalent to 90 n (LD50) of fast neutrons. A discrepancy in lethal action equivalent to 34.5 n is still to be accounted for.

This discrepancy is easily accounted for if we consider the contribution of ionizing particles emitted in tissue by the reaction $N^{14}(n,p)C^{14}$. If we take the nitrogen content of the mouse to be 3 per cent by weight, assume that the currently quoted capture cross section of nitrogen (1.7 barns) is entirely due to the n, p reaction, and take 0.60 Mev to be the kinetic energy shared by the proton and the C^{14} nucleus, it is found that this reaction, during an exposure of 375 arbitrary units, contributes an energy increment of 8500 ergs per gram of tissue, or 102 rep. Since the biological effectiveness of a rep of protons and C^{14} nuclei should be essentially the same as that of a rep of fast neutrons (protons and C, N, O nuclei), and since 1 n of fast neutrons is currently considered equivalent to 2.5 rep, a dose component of 102 rep of fast nuclei is equivalent in lethal action to 41 n.

This figure obviously more than accounts for the dose discrepancy (equivalent to 34.5 n) which was mentioned at the end of the last paragraph but one. The agreement is well within the accuracy of some of the constants used in the calculations. It is expected that some of these constants will be bettered before issuance of a final report in the near future.

Various other dose components were qualitatively present: (a) gamma rays from capture of slow neutrons in the bismuth surrounding the animals during exposure; (b) gamma rays from inelastic scattering of fast neutrons by the bismuth; (c) beta and gamma rays from radioactive substances formed in the body of the mouse. All of these components were investigated by calculation, direct measurement or both and found to be negligible in comparison to the dose components discussed above.

Perhaps the most striking feature of the results is the prominence of the $N^{14}(n,p)C^{14}$ reaction. It will be noticed that at least three-fourths of the lethal action which can be ascribed to the slow neutrons is due to this reaction, while the remaining one-fourth can be ascribed to gamma rays emitted in the mouse because of slow neutron capture. However, the small size of the mouse tends to minimize the importance of the gamma rays in comparison to the nitrogen reaction. With increasing size of animal the gamma rays undoubtedly would be responsible for more and more of the lethal action.

15. Effects of Small Periodic Doses of Gamma Rays on Mice (BX12-13) -

P. S. Henshaw, E. F. Riley, G.E. Stapleton.

No new developments.

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16. Delayed Effects of Single Gamma Ray Doses on Mice (BX12-14)
P. S. Henshaw, E. F. Riley, G. E. Stapleton.

No new developments.

17. Delayed Effects of Single Doses of Fast Neutrons on Mice (BX12-15) - P. S. Henshaw, E. F. Riley, G. E. Stapleton

No new developments.

18. The Absorption of Strontium (BX12-16) - H. J. Curtis.

No work has been done on this assignment during the past month. It is hoped that this problem can be concluded next month.

19. Effect of Small Periodic Doses of Fast Neutrons on Mice (BX12-17) -
P. S. Henshaw, E. F. Riley, G. E. Stapleton.

20. Delayed Effects of Single Doses of External Beta Rays (BX12-18) - J. R. Raper.

While no special effort has been made at this time to collect and organize data on delayed effects following single doses of beta rays a few observations of interest have been made from time to time. All of the following findings are based on groups of animals irradiated about November 1, 1944 or a little more than five months ago. The dose levels involved are the highest doses in which a high percentage of animals survived; for rats 5000 r and for mice 4000 r and 4500 r.

- (1) (1) Opaque eyes are a very common occurrence in groups of mice receiving 2500 r or more. The incidence approaches 100% at 4000 r. From casual inspections of such groups from time to time it would appear that the opacity develops slowly over a period of months, beginning at about 3 months. However, photographs of several animals in various groups show that in each animal this development is quite rapid; pictures taken at 2 week intervals have, in most cases, recorded that transition from clear to quite opaque eyes. This effect has not been observed in rats or rabbits.
- (2) Tumors have been seen in a number of cases both in rats and in mice. In mice, tumors on the ear and on the back are found in groups receiving 4000 - 4500 r in 5-10% of the animals. In most of the rats receiving 5000 r, warts of varying sizes have appeared. Some of these, about 1 cm in diameter, appear to be malignant.
- (3) Breakdown of skin forming open lesions frequently occur in places which had appeared for months to be completely healed. These lesions are sometimes quite large and require several weeks to reach maximum size after which they may heal equally slowly. This type of effect has been observed on a large number of mice and on a few rats, all receiving high doses.

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HEALTH DIVISION

and

BIOLOGICAL SECTION OF THE RESEARCH DIVISION

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Per Letter Instructions Of

710-1040

M.S. for N.T. Bray
4-2-54

CONF

REPORT FOR MONTH ENDING MAY 15, 1945

J. E. Wirth, M.D. - K. Z. Morgan
and H. J. Curtis

Series A Received: 5/24/45
Series B Received:

Series A Issued: 5/24/45
Series B Issued:

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ABSTRACTS

I. Medical Section of Health Division

None.

II. Health-Physics Section of Health Division

A routine check by the Medical Technicians of the hands and shoes of persons working at Clinton Laboratories indicates that only a few persons are careless about removing body and clothing contamination.

All the badge meter readings seem to be due to radiation exposure and the frequency of coincidences between the pocket meter readings and badge meter readings is probably as good as can be expected.

The survey of the drainage system of Clinton Laboratories has been completed and it indicates that there are 69.3 curies retained in the mud between the settling pond and the Clinch River. This figure is encouraging in view of the fact that about 1/2 curie was discharged per day from the Settling Pond during the period of operation of the Plant.

A new system of using Survey Report Diagrams makes the data more immediately available to the Supervisors and men working in the radiation areas. The data is more readily accessible also for future reference.

A number of new HP instruments are under calibration and operational tests.

It seems that the delayed neutron method of detecting product in wounds is theoretically possible but presents rather difficult problems.

III. Biological Section of Research Division

The animals given single treatments with slow neutrons (134 to 520 n) during August and September 1944, continue to die with tumors. Thus far more than 20 have died and been brought to autopsy. All of these have shown evidence to neoplasia. While the number of positive cases is not large, no other experimental series has given such a consistent yield. In the other series treated with other radiations, part of the animals died with a picture of generalized atrophy and part with neoplasia. The slow neutron treated animals have shown a variety of manifestations including leukemias, mediastinal masses, general lymph adenopathy, splenomegaly, ovarian tumors, subcutaneous tumors and one unusual pulmonary tumor.

All of the chronic series which are contemplated for all of the radiations have now been started.

CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

Report by J. E. Wirth, M.D.
Medical Director

1. Medical Activities

- (a) Pre-employment, termination and annual physical examinations have continued.
- (b) Dispensary service continued on a 24 hour basis. Personnel illness rate is continuing on a slightly lower level.

2. Clinical Laboratory

- (a) Routine blood counts and urinalyses are being continued at a constant level.

3. Special Hazards

See Health-Physics Section of this report.

4. Personnel

No change.

CLINTON LABORATORIES

II. HEALTH-PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

1. Personnel and Clothing Contamination

The question of persons leaving the Clinton Laboratories Plant with contaminated hands and clothing was raised in the Special Hazards Committee meeting on November 24, 1944. At this time it was felt that most groups of persons working in the Restricted Area were adequately monitored for contamination, but that it was possible for other persons in the Plant to work in contaminated areas and leave the Plant without checking their bodies and clothing for contamination. As a consequence of this discussion, a system was set up in the Medical Building (719) by which all persons in the plant would be checked with a four-fold hand counter and foot counter each time they reported for a routine blood count. The apparatus was made automatic and the records are being kept by the Medical Technicians.

The results of this survey for the period 1/1/45 - 4/20/45 are as follows:

| <u>Hand Activity</u> <u>in counts/min.</u> | <u>Number of Persons</u> <u>having Hand Activity</u> | <u>Foot Activity</u> <u>in counts/min.</u> | <u>No. of Persons</u> <u>having Foot Activity</u> |
|---|---|---|--|
| 0 - 70 | 1961 | 0 - 625 | 2028 |
| 70 - 130 | 69 | 625 - 950 | 4 |
| 130 - 200 | 28 | 950 - 1280 | 6 |
| 200 - 270 | 9 | 1280 - 1900 | 5 |
| 270 - 330 | 5 | 1900 - 3300 | 4 |
| 330 - 700 | 14 | 3300 - 5000 | 2 |
| 700 - 800 | 4 | 5000 - 9000 | 1 |
| >800 | None | >9000 | None |

In the above table the hand and foot activity is reduced to counts/minute on the standard counter which is a thin-walled glass counter contained in a lead box with a 4" x 4" window 3-1/4" above the sensitive portion of the counter (see letter on Standards by K. Z. Morgan to Clinton Laboratories Supervisors 4/30/45). The tolerance value set for hands is 700 c/m and the value for the outside of shoes is 10,000 c/m. The data collected by this survey to the present time has indicated that a few persons are carrying some contamination about with them, but the problem does not seem to be serious.

Octupl have been placed in the Restricted Area gates and in the Clock Alley gates, in a further effort to reduce the contamination carried on the bodies and clothing of Clinton Laboratories personnel. This apparatus has been in operation only a few weeks but the preliminary indication is that there are not many badly contaminated persons passing through these gates.

2. Personnel Monitoring Meters - J. E. Bradley

Several months have elapsed since the pocket meter or badge meter data has been summarized in a monthly report. During this time the total number of pocket meter readings per month has declined considerably due to changes in personnel and a change in meter distribution for visitors in the Restricted Area. These visitors are now given a badge meter instead of two pocket meters when they enter the Restricted Area. Consequently, since fewer pocket meters are used, they may be subjected to a stricter selective and testing procedure, and only the better ones are put into general use. This has caused a noticeable decrease in the percentage of double off-scale readings, as is shown in Table I. The last column gives the expected percent of double off-scale readings from a statistical point of view provided there is no radiation exposure.

Table I

| <u>Month</u> | <u>Total Pocket Meter Readings</u> | <u>Observed % of Single Off-scale Readings</u> | <u>Observed % of Double Off-Scale Readings</u> | <u>Expected % of Double Off-scale Readings</u> |
|--------------|--|--|--|--|
| Sept. 1944 | 40,087 | 4.11 | 0.192 | .169 |
| Oct. " | 36,069 | 2.92 | 0.219 | .085 |
| Nov. " | 34,311 | 3.62 | 0.172 | .131 |
| Dec. " | 29,625 | 3.66 | 0.104 | .134 |
| Jan. 1945 | 28,496 | 4.12 | 0.185 | .170 |
| Feb. " | 28,174 | 1.71 | 0.085 | .029 |
| March " | 28,596 | 3.12 | 0.077 | .097 |
| April " | 23,523 | 1.21 | 0.072 | .015 |

A much larger percent of the pocket meters with readings between 100 mr and 200 mr are significant than those with both readings > 200 mr. Table II tends to emphasize the importance of pocket meter readings when they are between 100 and 200 mr. All the badge meter readings > 100 are considered significant but some of the high pocket meter readings are due to leakage and rough handling of the meters.

The badge meters are read normally every two weeks and the pocket meters every day. In addition the badge meters are read immediately if both pocket meter readings are > 50 mr. Some of the discrepancies between columns (2) and (4) of Table II are due to persons receiving small daily

exposures on the pocket meters which add up to >100 mr on the film when it is read at the end of the two week period. The visitors into the Restricted Area wear only the badge meters. However, only one visitor has had a badge meter reading >100 mr during the 8 month period.

Table II

| <u>Month and Year</u> | <u>Badge Meters >100 mr</u> | <u>Coincidences between Pocket meters off-scale and badge meter >100 mr.</u> | <u>Coincidences between pocket meters reading from 100 to 200 and badge meter >100 mr.</u> |
|-----------------------|---|--|--|
| Sept. 1944 | 52 | 2 | 16 |
| Oct. " | 61 | 6 | 24 |
| Nov. " | 51 | 5 | 40 |
| Dec. " | 33 | 1 | 12 |
| Jan. 1945 | 91 | 0 | 35 |
| Feb. " | 36 | 2 | 26 |
| March " | 24 | 0 | 9 |
| April " | 38 | 0 | 27 |

3. Survey of Clinton Laboratories Drainage System - L. H. Weeks et al

An extensive assay of the mud in the White Oak Creek Drainage System for area contaminated, depth of contamination and curie content has been completed. A map of this area between the Settling Pond and the Clinch River has been prepared from Stadia surveys made of the contaminated area and a USC and GS map.

The contaminated portion of White Oak Drainage System can be divided into four principal areas, namely, the Marsh section, the Intermediate Pond, the Mud Flats of White Oak Lake, and White Oak Lake. The Marsh section, which is about 1400 feet below the Settling Pond was made by placing the upper dike across the old White Oak Creek stream bed and diverting the water out into a flat meadow. A large amount of filtering and settling takes place in this Marsh area and more than half of the total radioactivity found in the drainage system is located here. The Intermediate Pond formed by the lower dike shows the next highest contamination. The water is returned to the old stream bed at this lower dike.

White Oak Lake is divided into two sections by a row of trees across its center which serves as a convenient boundary between the Lake proper and the Lake Mud Flats. The section below the trees has a steep bank and a large part of this area is covered by water at all times, while the upstream section is a very flat valley which is covered by water only during the high water periods. For the past six months the upper

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WHITE OAK CREEK & LAKE

226.7' - 1000

Sitting pond

Lower river

WHITE OAK LAKE
MUD FLAT

WHITE OAK LAKE

CLINCH RIVER

4/24

flood gate of White Oak Lake Dam has been left open in order to prevent the dam from washing away during the spring rain season. The upstream section of the lake consists of mud flats at the present low level of the water and is flooded periodically during each rain. The major portion of activity in White Oak Lake is in the mud flats.

In addition to the above areas an assay was made also of the section below the spillway where slight contamination has been noted in previous surveys of this area. (Additional information is given in report of L. H. Weeks to K. Z. Morgan, 5/9/45). The table below summarizes the data on the distribution of radioactive fission products in the drainage system of Clinton Laboratories as of May 1, 1945.

| | Max. depth of contamination in inches | Avg. μ c/ sq.ft. | Contaminated area (sq.ft.) | Total curies |
|------------------------------------|---|-------------------------|-------------------------------|--------------|
| Marsh | 12* | 91.5 | 466,000 | 42.7 |
| Intermediate Pond | 8 | 87.6 | 52,300 | 4.6 |
| W.O.Lake Mud flats (N of trees) | 6 $\frac{1}{2}$ | 22.0 | 680,000 | 14.9 |
| W.O.Lake Mud flats (S of trees) | 6** | 8.5 | 795,000 | 6.8 |
| Area below Spillway | 5 | 1.04 | 300,000 | .3 |
| Total..... | | | | 69.3 |

* Contamination was found at three points below 12" but contamination below this depth was negligible compared to that on top of pond.

** One point was found near the Spillway to be contaminated at 11" from top, but this was exceptional in this area.

4. Work Area Surveys - W. H. Ray et al

During the month Survey Report Diagrams have been instituted for nearly all laboratory rooms. An inspection of this file reveals the large amount of work done in routine health surveys. The survey data recorded in this form is not only more immediately available to the Supervisors and men working in the laboratories but it is more readily accessible for future use.

The response of the Supervisors who sign for their respective copies of the survey diagrams has ranged from the extreme of "waste-basket filing" without a glance, to very careful consideration. In one area a major clean-up effort resulted from the improved reporting procedure.

5. New Equipment - R. H. Firminhac and L. J. Deal

Six "Victoreen" air samplers were received and put in operating order during the past month. Before placing them into general use, carts were constructed on which to move them. The instrument is no less cumbersome than the Clinton precipitrons, but may prove more dependable. However, it should be said that the Clinton Precipitrons have given excellent service and almost no trouble due to break-downs during the past six months.

Fifteen L & W survey meters have just been received. Four were not in working condition when received and the others are being calibrated and put through preliminary operational tests. Twelve rebuilt Victoreen survey meters have been received recently. The calibration on all of them is low on the high end of the scale. A tabulation of operational data on these instruments is being made.

A high pressure hydrogen chamber using the same electrometer and timing system as is used on the L & W survey meter is being tested on a loan from Dr. E. O. Wollan. The instrument itself works reasonably well, but the interpretation of the readings from such an instrument seems to present some problems.

The electrical breakdown of insulation has caused considerable trouble in the operation of the "Killer-Diller" hydrogen chamber.

A good, gamma free, fast neutron source would be very helpful in the calibrating of fast neutron instruments.

6. Development Work - R. H. Firminhac et al

Work has continued on the problem assignments to this group that are considered to be of first priority, namely:

1. Measurement of product in wounds by a measurement of the fission neutrons when the product is irradiated with slow neutrons.
2. Development of a practical method for continuously monitoring air samples.
3. The construction of a fast neutron measuring device that will be easy to operate and at the same time as sensitive and as reliable as Chang and Eng.

The possibility of estimating the amount of product in wounds by direct measurement of the fast fission neutrons has been ruled out by the detection and measurement of an appreciable fast neutron flux in the thermal column and by calculations of R. Scalater showing that thermal flux free of fast neutrons of sufficient intensity is not available from the Clinton Pile. The measurement of as low as 10⁻⁴ gms of product by delayed neutron measurement is still at best theoretically possible with the present thermal column neutron flux of 10⁷ n/cm²/sec. The principal difficulty is found in the development of an instrument capable of measuring the fifty neutrons emitted during the first minute after product in the wound is activated. (See letter of K. Z. Morgan to R. H. Firminhac 4/13/45).

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CLINTON LABORATORIESIII. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief

1. Development and Measurement of New Sources (BX8-3) - J. R. Raper
K. K. Barnes

New beta ray sources are being developed which have as their active principal a mixture of Sr^{89} and Sr^{90} . These sources have a half-thickness absorption value only about half that of the p^{32} sources used in all previous beta ray exposures. Exposures with these new sources should give interesting information on the cell layers of the skin responsible for the beta ray damage which has been observed.

2. Comparative Studies on Acute Effects of Beta Rays (BX12-1) - J. R. Raper
K. K. Barnes

Exposures are continuing on this assignment but there is nothing new to report.

3. Effects of Small Periodic Doses of External Beta Rays on Rats (BX12-2) -
J. R. Raper, K. K. Barnes.

Daily exposure of rats to doses of 50 r, 5 r, and 0.5 r of beta rays has been continued during the month. Doses of 2000 r, 200 r, and 20 r have accumulated to the present time. No effects resulting from these exposures have been observed.

Two groups of 24 mice each have been added to the list of animals receiving small doses of beta rays. These groups were first exposed on May 7, 1945, one receiving 50 r per day, the other 5 r/day. These groups, while somewhat smaller than those of the last being treated, will serve to demonstrate qualitatively any differences in effects of chronically administered exposures of beta rays in the two species.

The second "rat race" designed to deliver 500 r/day to rats, is at present being assembled and will be ready for use as soon as sources now in the pile have become activated.

4. Effect of Single Doses of Beta Rays to Restricted Area of Rabbits (BX12-3) - R. S. Snider, J. R. Raper, K. K. Barnes

Observations have been made twice each week on the rabbits receiving a single dose of beta rays to a restricted area on the side of the trunk. The picture of gross damage to this time, five weeks after exposure, follows that described for the former series of exposures (CH-2189, Oct. 1944). The damage in the treated area, however, is

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quite uniform in each animal due to the care taken to deliver uniform dose and the edges of the exposed area are very distinct in all but the lowest dose level. The evaluation of damage is much easier than in the former series where various degrees of injury were present within a single exposed area. Equal doses, it will be recalled, were administered to the skin of shaved and unshaved animals, correction being made for the absorption in hair of the unshaved rabbits. From the effects in the two cases up to this time, it appears that the reaction of the shaved skin is somewhat more severe. This point will be carefully followed in future examinations of the animals.

5. Recovery of Laboratory Animals from External Beta Ray Damage (BX12-4) - J. R. Raper, K. K. Barnes

This experiment is continuing but there is nothing new to report this month.

6. Additivity of Gamma and Beta Ray Effects (BX12-5) - J. R. Raper, K. K. Barnes

A number of animals have been exposed on this problem but no results are yet available.

7. Force Feeding of Rats Following Irradiation (BX12-6) - E. Anderson

No work has yet started on this assignment.

8. Effect of Age on the Radiosensitivity of Animals (BX12-7) - R. E. Zirkle.

No results are yet available on this assignment.

9. Metabolism Following Irradiation (BX12-8) - E. Anderson, K. K. Barnes

This experiment is continuing but there is nothing new to report this month.

10. Water Metabolism Following Irradiation (BX12-9) - E. Anderson

No work has yet been started on this assignment.

11. Biological Monitoring (BX12-10) - E. Anderson

No new developments.

12. Effects of Periodic Doses of Slow Neutrons on Mice (BX12-11) -

P. S. Henshaw, E. F. Riley, G. E. Stapleton

All of the chronic series have now been started on this assignment, and results will be complete in about a year.

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13. Biological Effects of Single Doses of Slow Neutrons on Mice (BX12-12) -

P. S. Henshaw, E. F. Riley, G. E. Stapleton

The animals given single treatments with slow neutrons (134 to 520 a) during August and September 1944, continue to die with tumors. Thus far more than 20 have died and been brought to autopsy. All of these have shown evidence of neoplasia. While the number of positive cases is not large, no other experimental series has given such a consistent yield. In other series treated with other radiations, part of the animals died with a picture of generalized atrophy. The slow neutron treated animals have shown a variety of manifestations including leukemias, mediastinal masses, general lymph adenopathy, splenomegaly, ovarian tumors, subcutaneous tumors and one unusual pulmonary tumor.

All animals necessary to complete the chronic irradiation program as well as animals to complete the histological sacrifice series have now been treated.

14. Effects of Small Periodic Doses of Gamma Rays on Mice (BX12-13) -

P. S. Henshaw, E. F. Riley, C. E. Stapleton

All the series which are contemplated on this assignment have now been started.

15. Delayed Effects of Single Gamma Ray Doses on Mice (BX12-14) -

P. S. Henshaw, E. F. Riley, G. E. Stapleton

All of the chronic series which are contemplated on this assignment have now been started.

16. Delayed Effects of Single Doses of Fast Neutrons on Mice (BX12-15) -

P. S. Henshaw, E. F. Riley, G. E. Stapleton

Many of the animals in this group have now reached terminal stages showing for the most part generalized atrophy or neoplasia. As soon as more of the results are available an analysis will be made of them.

17. The Absorption of Strontium (BX12-16) - H. J. Curtis

No work has been done on this assignment during the past month. It is hoped that this problem can be concluded next month.

18. Effect of Small Periodic Doses of Fast Neutrons on Mice (BX12-17) -

P. S. Henshaw, E. F. Riley, G. E. Stapleton

All of the chronic series which are contemplated on this assignment have now been started. Some of the groups whose treatments have been started during the summer of 1944 have terminated and summaries are being prepared.

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19. Delayed Effects of Single Doses of External Beta Rays (BX12-18) -
J. R. Raper

All of the chronic series contemplated on this assignment have now been started.

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4-2-54 SUPERVISOR LABORATORY RECORDS
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REPORT FOR MONTH ENDING JUNE 15, 1945

K. Z. Morgan and H. J. Curtis

Series A Received: 6/21/45
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CLINTON LABORATORIESHEALTH-PHYSICS SECTION OF HEALTH DIVISION

Report by - Karl Z. Morgan, Section Chief

The badge meter readings of persons who received an exposure of as much as 100 mr/2 weeks from April 1945 through July 1945 were about 20% lower than the pocket meter readings. Two-thirds of all these exposures to Clinton Laboratories personnel were to Chemists and Health-Physicists working in the Hot Laboratory (706-C). No weekly over-exposures (> 700 mr/week) have occurred during this period.

Each person working in 706-C during Hot Run #8 wore eight film badges distributed over various parts of the body, in an effort to determine whether or not the regular badge meter gives a representative reading when worn at the usual location between belt and chest height. The total film exposures at various body locations for the Hot Run (given in terms of percent of the regular badge meter readings) are as follows:

| | |
|---------------------------|-------|
| Regular Badge Meter | 100% |
| Film meter on right leg | 78.2 |
| Film meter on left leg | 80.0 |
| Film meter on right wrist | 105.0 |
| Film meter on left wrist | 96.8 |
| Film meter on crotch | 73.3 |
| Film meter on chest | 88.5 |
| Film meter on back | 59.0 |

Hot runs #8 and #9 in 706-C were run in quick succession without any radiation accidents.

The samplers appended to the cell walls in the new Barium Production Building (706-D) have been the principal source of radiation in the working areas of this building. Readings as high as 7000 mr/hr were measured on one of the samplers on 6/16/45.

Activated irridium powder was spilled and tracked about Bldg. 105 on 5/28/45 and was cleaned up after an extensive cleanup campaign.

Initial service tests on the L & W and Zeus survey meters indicate that they are very satisfactory instruments.

Satisfactory neutron and product instruments are in the first stage of development.

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6/20/45

CLINTON LABORATORIESBIOLOGY SECTION OF RESEARCH DIVISION

Report by H. J. Curtis, Section Chief

In the construction of beta ray sources, it has been found that scattering from the backing material is very important and may amount to as much as 86% of the ionization due to the primary radiation. A preliminary study indicated that the particles scattered back from a thick surface is proportional to the square root of the atomic number of the scattering material and amounts to 70% in the case of bismuth. The energy is roughly proportioned to the atomic number.

The animals which were exposed to beta rays over a restricted area of the lumbar portion of the back during September 1944, were examined during the month. Ulceration and associated necrosis were found in three of the animals, all receiving 15000 r or more; the necrotic area of one extending through the muscular layer under the skin and exposing the fibrous tissue covering the spinal processes. Late ulceration in these cases represent a second breakdown of the superficial layers of skin, all of the treated animals having "completely" healed by 120 days following irradiation. In all other cases the skin of the treated area was apparently sound but appeared dry, scaly, frequently thickened in small areas, and in some few cases fixed to underlying tissues. There has been no regrowth of hair in areas which have been severely damaged and the size of the epilated area compared to the areas at three months indicates that a second wave of epilation has occurred in the meantime in the peripheral portion of the exposed area.

Recovery from beta ray damage as indicated by ability to withstand a second dose of beta rays follows roughly an exponential course with a half recovery time of about 2-1/2 days. Recovery is 100% complete after 10 days but then keeps on increasing to a maximum of 120% at 28 days and then returns to normal or 100% at 56 days. This indicates that the initial radiation has afforded some protection for a short period of time against additional exposures. Since the epidermis is considerably thickened at 56 days, this result seems to indicate that acute killing depends only upon the absorption of a definite amount of energy by live tissue.

The physiological picture of the response of a rat to a single large dose of beta rays is becoming increasingly clear. The tissue breakdown occurs so slowly that compensation can take place much better than in the case of thermal burns, so there is probably no reduction in blood volume and consequently no secondary shock.

A large fraction of the biological monitoring is being discontinued.

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A study has been made of the lung tumor incidence in Strain CF₁ mice following a single large dose of gamma rays. 693 animals were used in the study. It was found that the incidence of animals with tumors varies between 50% and 76% in the groups studied and is substantially the same in both the irradiated and control groups. Furthermore the time of induction, the number of tumors per mouse, the size of the tumors, and their behavior is the same as for the controls. It must therefore be concluded that up to 8 months of age this radiation, as used, is not carcinogenic for lung tumors.

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HEALTH DIVISION

AND

BIOLOGICAL SECTION OF RESEARCH DIVISION

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Per Letter Instructions of

AEC 3-26-53

ms for N.T. Bray
5/28/53
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GML

REPORT FOR MONTH OF OCTOBER -1945

BY

K. Z. Morgan and H. J. Curtis

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November 15, 1945

CLINTON LABORATORIES

HEALTH PHYSICS SECTION OF HEALTH DIVISION

by

K. Z. Morgan - Section Chief

Health-Physics reports from the Chemistry building, 706-A, indicate a definite improvement of Health conditions during the past month insofar as radiation hazards are concerned. This improvement is general and not the result of a special campaign in one or two sections.

Rebuilding of the apparatus for Cell B in the Barium Separations Building (706-D) has been the chief occupation of that group this past month. A new record has been established in that no overexposures have been recorded for personnel in this building for a period of two weeks.

Decontamination of bank II in the Hot Laboratory (705-C) has reached a point of diminishing returns. Lead linings are being placed around the remaining "hot" areas in the cells to shield workers who are installing new equipment.

On November 7, 1945, the East Retention Pond was drained. Electroscope readings at the bottom were about one mr/hr. Smear tests showed from 900 to 3500 counts/min. of β and γ but no α contamination. Prior to July 1944, when the new Settling Pond was placed in operation, liquid waste from the plant passed through the Retention Ponds on its way to White Oak Creek. Since then these ponds have carried only the cooling and seal pit water which has seldom been active. The decay of activity on the bottom of the East Retention Pond to this low level leads one to expect a similar rate of decay in the Settling Pond if it were out of use for a corresponding period of time.

Since the cleaning of the inlet weirs all readings along the banks and cat-walks of the Settling Pond for the past month have been less than 5 mr/hr. Readings at these same locations formerly ranged from 10 to 25 mr/hr.

Recalibrations of Lauritsen electroscopes equipped with boron carbide lined chambers have indicated very little change in sensitivity to thermal neutrons after several months use. The calibration checks are made by comparison with Indium foils.

A new model Victoreen integron has been installed in the Pile Building (105) for a trial run. Its operation for a period of two weeks cannot be classed as completely satisfactory. Erratic zero setting appears to be one defect of the new model. A report by the instrument section will be made following an extended period of observation.

A Bi-Be alloy made by Battelle is being bombarded in the pile at a flux of 2.37×10^5 N/cm²/sec/watt.

Several fission chambers are being made by electroplating Uranium oxide containing various amounts of U²³⁵ on the inside of the cylinders.

A cloud chamber for special Health Physics measurements is under construction.

Increasing the diameter of the Butane fast neutron counter chamber about three times does not seem to raise the threshold or working voltage markedly. The efficiency of the larger chamber for recoil protons should be increased.

Work in the product urinalysis group is continuing on precipitation processes. A rather thorough study of the carrying of product from urine by calcium oxalate is being made. The method shows considerable promise. A small laboratory for medium product activity work is being constructed in a spare room in the hospital.

The supply of monitoring instruments now seems to be quite adequate at Clinton Laboratories. It is anticipated that more effort will be spent in determining the merits and limitations of the various types of instruments so that further standardization can be accomplished.

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CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

by

H. J. Curtis - Section Chief

Studies are now complete on the comparative effects of beta and gamma rays on animals of different sizes and shapes. It has been found that the ratio of the total beta ray energy to cause 50% mortality to the total gamma ray energy absorbed to produce the same effect, varies inversely as the gamma ray dose necessary to produce 50% mortality. From this, it follows that the amount of energy absorbed as beta rays necessary to cause death is directly proportional to the mass of the animal. This result has interesting implications from a theoretical point of view.

It has been found that when animals are irradiated simultaneously with beta and gamma rays there is some, but by no means complete, additivity of the lethal effects of the two radiations. When the same doses of the same radiations were given not simultaneously but spaced so that the main wave of mortality due to beta rays would coincide with the wave of mortality due to gamma rays the effect was to reduce the additivity practically to zero. This result was totally unexpected and is difficult to explain.

It was found several months ago that the effects obtained with two different gamma ray sources were considerably different. In investigating this discrepancy, every factor was eliminated except the dosage rate, which was about 30 r/min. in one case and 4 r/min. in the other. It has now been proven that this difference in dosage rate is sufficient to cause nearly a 50% difference in lethal effect in mice. Since the longest duration of exposure was four hours, this result indicates that the exposure time must be carefully considered in comparing exposure effects.

Сезу 12А

AND •

BY

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Per Letter Instructions Cf

TID 1116

11-5-56 M. Shirley

For: M. T. Bray, Supervisor

Laboratory Records Dept.

ORNL

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December 31, 1945

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CLINTON LABORATORIES

MEDICAL SECTION OF HEALTH DIVISION

by

J. E. Wirth, M.D. - Medical Director

Dispensary

The clinic is still short of nurses. The amount of night dispensary work between 4 P.M. and 8 A.M. has dropped to a new low. The illness rate has shown a marked increase in the last 6 weeks. Most of this illness is seasonal and takes the form of flu, la grippe, colds and upper respiratory infections. There has been a decrease in gastro-intestinal disturbances. It is believed that only a very small part is due to a relaxation, on the part of some individuals, of the drive to win a war. Employees adjustment from war to peacetime work is going through a slow transition period despite the slight change in type of work being done.

The accident rate has remained about 1.9 (injuries per million manhours of work) during the last 3 months. This is somewhat lower than the previous 3 months. Minor accidents run a steady course.

The sanitary conditions in the cafeteria have shown a marked improvement.

Clinical Laboratory

No unusual findings noted. Finger ridge studies are being continued.

General and Miscellaneous

The medical records of all Monsanto Clinton Laboratories' employees are being copied by a photostatic process so that an entire record will be available at Clinton Laboratories. The originals will be forwarded to Chicago. It is estimated that the job will be completed by February 1, 1946.

Activity Hazards

The decrease in general contamination in the laboratories of the chemistry building is very gratifying. One may note, however, that it is coincident with the increase in the amount of writing being done on the P.P.R. during the last two months.

December 31, 1945

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CLINTON LABORATORIES

HEALTH PHYSICS SECTION OF HEALTH DIVISION

by

K. Z. Morgan - - Section Chief

Work Area Surveys (W.H.Ray and R.E.Hayden)

Two instrument men contaminated their hands so badly that a Zeus beta instrument read 23 mr/hr when placed in contact with their hands. The contamination was received on 11/16/45 while the men were working with a cell probe on top of the cells in the Barium Separations Building (706-D). This hand contamination was not discovered until the men set off the octopus alarm as they were entering the locker room. The work had been done on the probe without obtaining a Health-Physics clearance survey and without the use of gloves. Before the activity was discovered, the probe reading 2 r/hr had been taken to the instrument room, contaminating this part of the building.

Hot run number six started on 11/23/45 in the 706-D building. The first fifteen slugs stuck in the delivery chute. It was necessary for the building supervisor to enter Cell A in a field of 6 r/hr for 15 seconds to determine the difficulty. It appeared that the last slug of a previous dummy run was an irregular Argonne type and had blocked the chute. A solution of 60% nitric acid placed in the chute dissolved and removed the obstruction in about 5 minutes. The off-gases resulting from this treatment were discharged outside the building by means of an air ejector at the slug chute opening.

On the previous hot runs in the 706-D building, half hour air samples were taken about four times each 24 hr. day. On this last run air samples were taken for 250 hours of the 330 hours of the run. The samples were taken with Filter Queens and Clinton precipitrons. Six air samples counted higher than the beta-gamma tolerance level of 10,000 c/m for a half hour collection at a rate of 11.5 cubic feet per minute. The "hottest" sample counted 50,000 c/m. The exact cause of this high air activity is not known but part of it may have been the result of a blowback to the panel board on top of the cells and vapors given off from the hot sink drains due to the lack of proper sink traps.

The pile exit duct was entered during a shutdown on 12/6/45 in order to make a survey to determine the advisability of making repairs inside the pile chimney. Persons engaged in this operation wore protective clothing and masks. Readings as high as 30 r/hr were found at the top of the ledge at the opening of the chimney into the discharge room. Some of the loose Cellamite removed

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December 31, 1945

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from the chimney was very radioactive as indicated by a reading of 1 r/hr when a Cutie Pie meter was placed against a waste basket full of the hotter material that had worked loose from the upper chimney. A decay curve showed the activity was due to radioactive sodium. The cellamite contains sodium that had been exposed to a beam of thermal neutrons from the back face of the pile.

Urine Analysis Laboratory (M. E. Koshland and L. M. Brown)

Work on the Urine Analysis Laboratory is very slow. The probable completion date is in March.

Two analytical procedures for recovering traces of product in urine are being investigated. They involve direct precipitation from the urine. One method used BiPO_4 and the other $\text{Ca}(\text{C}_2\text{O}_4)$. Both methods give a recovery from low level plutonium spiked urine of better than 80%.

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December 31, 1945

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CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

by

H. J. Curtis - - Section Chief

In investigating the lethal effects of external beta rays on mice, an experiment has been completed showing the effect of the energy of the beta particles. For this purpose lead-backed Sr* sources were used having a half thickness value of 63 mg/cm² as compared with the previous P³² plaques having a half value thickness of 80 mg/cm². The LD50 dose for the Sr* was found to be 5500 rep as compared to 4700 rep for P³². This difference is more apparent than real, since if a correction is made for the absorption of energy in the hair, and then expressed as the total amount of energy absorbed by a mouse, it is found that the value for Sr* is 28,800 rep-grams while for P³² is 31,800 rep-grams. Part of this discrepancy can be explained as due to the differences in absorption in the cornified epithelium and part to the fact that there is some small amount of very penetrating beta radiation from Y⁹⁰ in the Sr* source which increases the effective half thickness value. Therefore, within these limits it appears that the lethal effects of different types of beta rays can be predicted on the basis of the total energy absorbed.

Tests have been conducted to determine whether the lymphoid tumors produced by gamma, fast neutron and slow neutron radiation are transplantable in order to obtain a better understanding of the degree of malignancy of these tumors. A number of growths which were classed as malignant lymphomas were removed and small pieces transplanted by sterile technique to the peritoneum of normal mature mice. Some of the transplanted tissues continued to grow profusely while others died out. The reason for the failures may be faulty technique, selection of the wrong stage of malignancy or that these tumors are non-transplantable.

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HEALTH DIVISION

AND

BIOLOGICAL SECTION OF RESEARCH DIVISION

Ind for N.T. Bray
5/28/53 SUPERVISOR CENTRAL FILES
ORNL

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REPORT FOR THE MONTH OF JANUARY, 1946

BY

J. E. WIRTH, M.D., K. Z. MORGAN AND H. J. CURTIS

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January 31, 1946

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January 31, 1946

CLINTON LABORATORIES

MEDICAL SECTION OF HEALTH DIVISION

by

J. E. Wirth, M.D. - Medical Director

1. Medical Activities.

- a) Pre-employment and termination examinations have stayed on a constant level. Annual physical examinations have been resumed at a more rapid pace in an attempt to get the records up to date on all who have been employed for more than a year.
- b) Dispensary. Dispensary service has been interrupted periodically during the month due to the lack of nurses. Many of the night shifts have had to be omitted.

2. Clinical Laboratory.

No unusual findings noted. Routine blood counts and urine analyses have been performed monthly on restricted area personnel, and at 3 month intervals for all other personnel. Beginning February 1, 1946, this routine will be changed to once every 3 months for restricted area personnel, and once a year for all other personnel. Special counts and urine analyses will be obtained as indicated.

3. Medical Records.

The complete original medical records of all Clinton Laboratories^o personnel employed prior to 7-1-45 are being transferred to the University of Chicago files. In order that the Monsanto Chemical Company, Clinton Laboratories might have a complete record on all of its personnel including those who were employed prior to 7-1-45, photostatic copies have been obtained of all records of employees who were on the rolls prior to 7-1-45, of who had terminated prior to that date and re-entered thereafter. The task of obtaining photostatic copies has been completed and the vast majority of the charts have been checked, filed in packing boxes, and will be shipped out during the first week of February.

4. Special Hazards.

- a) A recommended health protection policy to be considered in plans for construction of the new heterogeneous pile

has been set up. The main difference between it and the policy for the present pile is a change from a tolerance of 0.1 r per day for any square millimeter of surface of the present pile to 0.1 r per day for any square centimeter surface of the new pile. The radiation from any area less than one square centimeter may be integrated over an entire square centimeter.

- b) The absence of or small numbers of over-tolerance exposures to radiation and incidents involving activity hazards is the result of positive action on the part of personnel to prevent them. Absence of them may also lull people into a false sense of security. It is hoped that the incidents reported in the Health-Physics Section (paragraphs 3, 4, and 10) are not an indication of a trend toward lack of positive action at Clinton Laboratories.

5. Personnel.

It is with regret that the Health Division notes the termination of Doctor Robert S. Stone from the Clinton Laboratories roll as of February 8, 1946.

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CLINTON LABORATORIES

MEDICAL SECTION - - HEALTH DIVISION

J. E. Wirth, M. D. - Medical Director

DISTRIBUTION OF EFFORT FOR MONTH OF JANUARY, 1946

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|---------------------|-------------------|-------------------|
| Physicians | 3 | 3 |
| Medical Technicians | 8 | 8 |
| Nurses | 5 | 6 |
| Office Personnel | <u>5</u> | <u>4</u> |
| | 21 | 21 |

Allocation of Time

Physicians

| | | |
|--------------------------|------------|------------|
| Physical examinations | 1 | 1 |
| Dispensary Service | 1 | 1 |
| Special Hazard Problems) | | |
| Haematology studies) | 1/2 | 1/2 |
| Administration | <u>1/2</u> | <u>1/2</u> |
| | 3 | 3 |

Medical Technicians

| | | |
|--------------------|------------|------------|
| Blood studies | 4 | 4 |
| Animal pathology | 3 | 3 |
| Urinalyses | 1/2 | 1/2 |
| General Laboratory | <u>1/2</u> | <u>1/2</u> |
| | 8 | 8 |

Nurses

| | | |
|--------------------------|----------|----------|
| Dispensary shift nursing | 4 | 5 |
| Visiting nurse | <u>1</u> | <u>1</u> |
| | 5 | 6 |

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CLINTON LABORATORIES

HEALTH PHYSICS SECTION OF HEALTH DIVISION

by

K. Z. Morgan - - Section Chief

A thorough radiation survey was made of the Clinton Laboratories' Cafeteria and equipment, and the only radioactive contamination found was a small amount of beta and gamma activity on the water dispenser and the outside door latches of the building.

Readings made with a portable Scaler and Walkie-Talkie at a distance of 2-1/4 miles down wind from the pile (operating at 3500 KW) were about four times as high as those taken up wind at the Medical Building inside the plant.

Airborne radioactive dust approached a tolerance level as graphite stringers were removed from the top of the pile. The job was held up by Health Physics until the fans were started.

A gold sample was thoughtlessly removed from the pile shield before it had cooled to a radiation level safe to handle. It was hurriedly placed in a wooden box in the center of the second floor level on the south side of the pile. The radiation was over 100 mr/hr forty feet away from the gold sample at the pile operating panel. The pile was kept shut off and the south side of the pile building was cleared of people. After six hours of effort in constructing a lead coffin and development and using remote handling devices, the gold sample was safety shielded. Eight over-exposures were traced to this incident.

Careful surveys are being made in the Plutonium Separations Building (204) while it is being renovated for use by chemists who will work with U²³⁵.

The general radiation background to the east and north of the Lanthanum Separations Building (706-D) was about 12 mr/hr during the past hot run due to airborne radioactive products from the cell ventilation duct on the east side of the building. Readings at the base of this duct reached 1200 mr/hr by the end of the run.

The new instrument in building 706-D for measuring continuously the beta and gamma airborne activity has been calibrated. A full scale increase in reading on the Esterline Angus recorder in 1/2 hour would correspond to about 17,000 c/m of β and γ activity for a precipitron operating this same time. This would be a little less than twice the present tolerance level of 10,000 c/m of β and γ activity for a precipitron sample collected for

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1/2 hour.

While cell 4 cubicle in building 706-D was being washed down, water ran out on the floor of the building. The contaminated area was evacuated for a short time since the fluid read 95 r/hr at a distance of 8" and the air samples on the third level read 10,200 c/m for a 1/2 hour collection. The building was cleaned up properly.

The new system of having the Health-Physics chief surveyors deliver the overexposure reports to the Section Chiefs and to those responsible for the overexposure is an improvement over sending them out by plant mail. The chief surveyor gets first-hand information about the overexposure and aids in filling out the exposure record blank with the desired information.

The daily report blanks from the analytical laboratory in building 205 giving the beta activity of the affluent and effluent water of the settling basin were not delivered for five days previous to January 24. This delay is very unusual and was caused by counter difficulties in the laboratory. The operations personnel made the mistake of continuing to discharge the settling basin during this period without the benefit of information from these reports. Some of the samples that were delayed in being counted turned out to be 15 times tolerance (400 c/m is taken as tolerance due to external radiation to a submerged body). The first indication of trouble was the unusually high Lauritsen electroscope readings that are taken routinely about the settling basin by Operations and Health Physics personnel. The radiation level at White Oak Lake rose to unprecedented heights and the strontium concentration at White Oak Lake reached tolerance (for continuous consumption). The White Oak Lake gates were closed but heavy rains overflowed the gates taking water, that was slightly above tolerance for strontium concentration, to Clinch River. The activity of the water and the mud from down Clinch River as far as Gallahue Gate was measured. Fortunately all these measurements indicated that the river dilution was sufficient to lower the concentration of radioactive materials in the water and mud to a negligible fraction of tolerance.

The loss of the SED men from the Health Physics section is presenting difficult problems of replacement and training. Regular class instruction is being arranged for twelve new men (three of these are for site M) who are to be in training as Health Physicists.

January 31, 1946

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CLINTON LABORATORIESHEALTH-PHYSICS SECTION - HEALTH DIVISIONK. Z. Morgan - - Section ChiefDISTRIBUTION OF EFFORT FOR THE MONTH OF JANUARY, 1946Personnel

| | |
|--|-----------|
| Physicists (Assoc. & Sr.) | 4 |
| Jr. Physicists & Research Asst's | 31 |
| Chemists | 1 |
| Junior Chemists | 2 |
| Laboratorians, Technicians & Secretaries | 26 |
| | <u>64</u> |

Allocation of TimeWeeklyMonthlyServices

| | | |
|---------------------------|---|---------------|
| Pocket Meters | 9 | 0 |
| Badge & Ring Meters | 7 | $\frac{1}{2}$ |
| Neutron Films | 2 | $\frac{1}{2}$ |
| Hand, glove & shoe counts | 2 | 0 |
| Laundry counting | 2 | 0 |
| Calibration | 1 | 0 |
| Surveys 100 Area | 0 | $\frac{1}{2}$ |
| Surveys 200 Area | 0 | $\frac{1}{2}$ |
| Surveys 706-A | 3 | 1 |
| Surveys 706B, C, & D | 0 | 6 |
| Mud, water & air surveys | 0 | 1 |
| Trainees | 0 | 9 |

Research & Development

| | |
|---------------------------------------|---|
| New Instrument development | 2 |
| Instrument tests | 1 |
| Slow neutron studies | 1 |
| Fast neutron studies | 1 |
| Methods of detecting product in urine | 4 |
| Preparation of PFR | 4 |

Administrative

2

Office Personnel2

28

36

January 31, 1946

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CLINTON LABORATORIES
BIOLOGICAL SECTION OF RESEARCH DIVISION

by

H. J. Curtis - - Section Chief

The chief effort of this section has been directed toward closing out and writing up the biological program. All experiments except the chronic effects of radiations are complete, and either written for publication or in the process thereof. Most of the writing will be complete by March 31, and the last of the animals disposed of when the program closes on June 30, 1946. The chronic experiments are progressing according to plan.

January 31, 1946

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CLINTON LABORATORIESBIOLOGICAL SECTION OF RESEARCH DIVISIONH. J. Curtis - - Section ChiefDISTRIBUTION OF EFFORT FOR MONTH ENDING 1/31/46

| <u>Personnel</u> | <u>This month</u> | <u>Next Month</u> |
|------------------------|-------------------|-------------------|
| Research Associates | 3 | 2 |
| Research Assistants | 5 | 5 |
| Technical | 3 | 2 |
| Non-Academic Personnel | 8 | 8 |
| Clerical | 1 | 1 |
| | <u>20</u> | <u>18</u> |

| <u>Allocation of Time - Academic</u> | <u>Rating</u> | <u>Man-Months</u> | |
|--------------------------------------|----------------|-------------------|----------|
| BX8-3 - Beta ray sources | C ₁ | 0 | 0 |
| BX12-1- Comparative studies | C ₁ | 0 | 0 |
| BX12-2- Periodic beta doses | C ₁ | 1/4 | 1/4 |
| BX12-3- Restricted area studies | C ₁ | 0 | 0 |
| BX12-4- Recovery from beta | C ₁ | 0 | 0 |
| BX12-5- Additivity | C ₁ | 0 | 0 |
| BX12-6- Force feeding | C ₁ | 0 | 0 |
| BX12-7- Effect of age | C ₁ | 0 | 0 |
| BX12-8- Metabolism | C ₁ | 0 | 0 |
| BX12-9- Water metabolism | C ₁ | 0 | 0 |
| BX12-10 Monitoring | A ₁ | 0 | 0 |
| BX12-11 Periodic slow n | C ₁ | 1/2 | 1/2 |
| BX12-12 Single slow n | C ₁ | 1/4 | 1/4 |
| BX12-13 Periodic gamma | C ₁ | 1/2 | 1/2 |
| BX12-14 Single gamma | C ₁ | 1/4 | 1/4 |
| BX12-15 Single fast n | C ₁ | 0 | 0 |
| BX12-17 Periodic fast n | C ₁ | 1/2 | 1/2 |
| BX12-18 Single beta | C ₁ | 0 | 0 |
| BX12-19 Bone metabolism | C ₁ | 0 | 0 |
| BX12-20 Vitality of mice | C ₁ | 1/4 | 1/4 |
| Care of animals | | 1/2 | 1/2 |
| Administration | | 1 | 1 |
| Reports | | 4 | 3 |
| | | <u>8</u> | <u>7</u> |

Allocation of Time - Non-Academic

| | | |
|-----------------------------------|-----------|-----------|
| Technicians - mouse weights, etc. | 3 | 2 |
| Clerical | 1 | 1 |
| Care of animals | 8 | 8 |
| | <u>12</u> | <u>11</u> |

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HEALTH DIVISION

AND

BIOLOGICAL SECTION OF RESEARCH DIVISION

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REPORT FOR THE MONTH OF FEBRUARY, 1946

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J. E. Wirth, M. D., K. Z. Morgan and H. J. Curtis

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February 28, 1946

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February 28, 1946

CLINTON LABORATORIES
MEDICAL SECTION OF HEALTH DIVISION

by

J. E. Wirth, M. D. - Medical Director

1. Medical Activities.

- a) There has been no change in the rate of pre-employment, termination or annual physical examinations.
- b) Dispensary. Dispensary service has been on a continuous 24-hour basis during the last month. The nursing situation has improved markedly.

2. Clinical Laboratory.

A new routine was begun on 2-1-46. Blood and urine analyses are to be performed on restricted area personnel once every 3 months, and once a year for all other personnel. The laboratory has spent a fair part of its time working out the new lists and getting all old files and records in good condition.

3. Medical Records.

The original medical records of Clinton Laboratories' personnel employed prior to 7-1-45 were finally transferred to the University of Chicago on 2-13-46. A general housecleaning of the remaining files is being undertaken. Arrangements are being made to complete the records of all terminated personnel and to combine the medical and Health-Physics files into one complete record.

4. Special Hazards.

There have been two meetings of the Activity Hazards Committee during this month. It is believed that these two meetings demonstrated the necessity for continued vigilance in order to prevent serious incidents. They also demonstrated their value in pointing out desirable changes or additions to the plant which might be overlooked by individual groups considering only their own local problems. The need for revision of the rules and procedures for the handling of active materials was brought out. Continuous change in the type of work being done necessitates frequent changes of these rules so that they may be kept up to date.

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CLINTON LABORATORIES

MEDICAL SECTION - - HEALTH DIVISION

J. E. Wirth, M. D. - - Medical Director

DISTRIBUTION OF EFFORT FOR MONTH OF FEBRUARY, 1946

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|----------------------------|-------------------|-------------------|
| Physicians | 3 | 3 |
| Medical Technicians | 9 | 8 |
| Nurses | 7 | 7 |
| Office Personnel | <u>4</u> | <u>4</u> |
| | 23 | 22 |
| <u>Allocation of Time</u> | | |
| <u>Physicians</u> | | |
| Physical examinations | 1 | 1 |
| Dispensary Service | 1 | 1 |
| Special Hazards Problems) | | |
| Haematology studies) | 1/2 | 1/2 |
| Administration | <u>1/2</u> | <u>1/2</u> |
| | 3 | 3 |
| <u>Medical Technicians</u> | | |
| Blood studies | 4 | 3 |
| Animal pathology | 3 | 3 |
| Urinalyses | 1/2 | 1/2 |
| Clerical | 1/2 | 1/2 |
| General Laboratory | <u>1</u> | <u>1</u> |
| | 9 | 8 |
| <u>Nurses</u> | | |
| Dispensary shift nursing | 6 | 6 |
| Visiting nurse | <u>1</u> | <u>1</u> |
| | 7 | 7 |

February 28, 1946

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CLINTON LABORATORIES

HEALTH PHYSICS SECTION OF HEALTH DIVISION

by

K. Z. Morgan - - Section Chief

Mr. S. D. Bloom has developed the photographic emulsion technique of Dr. L. B. Borst for detecting plutonium in urine. At present the method can be used to detect quantities as low as 20 disintegrations per minute and further refinements are expected to improve the sensitivity.

The mud activity along White Oak Creek is shown by Mr. J. S. Cheka to decrease exponentially with increasing distance from the settling basin. The distance required to reduce the activity one-half is approximately half a mile.

Mr. H. P. Gauvin using a boron lined Poppy chamber was able to measure thermal neutrons to a distance of 20 feet from the Pile building.

Number two fan for the pile needed emergency repair and it was found to have an unusually high level of contamination as indicated by 18 R/hr inside the housing. Special precautions were taken that prevented radiation overexposures during the operation.

The concrete floor in front of the lead cells in the Barium Separations Building (706-D) became badly contaminated. It was extremely difficult to remove the contaminated material that was absorbed in the concrete. It finally became necessary to cover the area with six inches of concrete. Concrete was also poured around the bases of tanks A1, A5 and A6 to reduce the level of radiation in cell A.

There was a spill of 30 hour tellurium and 8 day iodine from a condenser in the Isotope Separation Building (706-C). Mr. D. S. Ballantine entered the room immediately after the spill and the solution was sprayed about his face and in his eyes. After considerable washing the face read 650 c/m of beta and gamma activity as measured with an Eck and Krebs glass GM tube. The medical department reduced the activity to a safe level after further treatment.

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February 28, 1946

CLINTON LABORATORIES

HEALTH-PHYSICS SECTION - HEALTH DIVISION

K. Z. Morgan - - Section Chief

DISTRIBUTION OF EFFORT FOR THE MONTH OF FEBRUARY, 1946

Personnel

| | |
|--|-----------|
| Physicists (Assoc. & Sr.) | 4 |
| Jr. Physicists & Research Asst's | 28 |
| Chemists | 1 |
| Junior Chemists | 2 |
| Laboratorians, Technicians & Secretaries | 24 |
| | <u>59</u> |

Allocation of Time

Weekly

Monthly

Services

| | | |
|---------------------------|---|-------|
| Pocket Meters | 8 | 0 |
| Badge & Ring Meters | 6 | 1/2 |
| Neutron Films | 2 | 1/2 |
| Hand, glove & shoe counts | 1 | 0 |
| Laundry counting | 2 | 0 |
| Calibration | 1 | 0 |
| Surveys 100 Area | 0 | 1 1/2 |
| Surveys 200 Area | 0 | 1 1/2 |
| Surveys 706-A | 2 | 2 |
| Surveys 706B, C & D | 0 | 6 |
| Mud, water & air surveys | 1 | 1 |
| Trainees | 0 | 9 |

Research & Development

| | |
|---------------------------------------|---|
| New Instrument development | 1 |
| Instrument tests | 1 |
| Slow neutron studies | 1 |
| Fast neutron studies | 1 |
| Methods of detecting product in urine | 4 |
| Preparation of PPR | 3 |

Administrative

2

Office Personnel

1

24

35

February 28, 1946

MonH-73

CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

by

H. J. Curtis - - Section Chief

Experiments are now complete on the effects of small daily doses of fast neutrons and gamma rays on Strain C58 mice. This strain of mice normally develops leukemia and die at from 12 to 18 months of age, and the control mice in this series behaved in this way. Groups were irradiated at 1.15 n/day at fast neutrons; 8.6 r/day and 17.2 r/day of gamma rays. Except for a very few doubtful cases, none of the irradiated animals developed leukemia, and it could therefore be concluded that the periodic irradiation as given retarded rather than advanced the onset of leukemia. However, in all cases the irradiated animals died sooner than their controls.

An examination of the data shows that the animals receiving 1.15 n/day of fast neutrons produced about the same effect as 17.2 r/day of gamma rays as far as survival is concerned, while 8.6 r/day of gamma rays produced a much smaller effect. It has previously been found that the ratio of effectiveness for fast neutrons and gamma rays, as judged by acute effects, was $\gamma/n = 8.0$. From the experiments reported here it appears that for chronic effects the ratio is $\gamma/n = 16$. This is the first evidence which we have obtained which indicates that as far as the whole animal is concerned, there is a qualitative difference of effect between fast neutrons and gamma rays.

February 28, 1946

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CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

H. J. Curtis - - Section Chief

DISTRIBUTION OF EFFORT FOR MONTH ENDING FEBRUARY 28, 1946

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|------------------------|-------------------|-------------------|
| Research Associates | 3 | 2 |
| Research Assistants | 5 | 4 |
| Technical | 2 | 2 |
| Non-Academic Personnel | 8 | 8 |
| Clerical | 2 | 2 |
| | <u>20</u> | <u>18</u> |

| <u>Allocation of Time - Academic</u> | <u>Rating</u> | <u>Man-Months</u> | |
|--------------------------------------|---------------|-------------------|----------|
| BX12-2 - Periodic beta doses | C1 | 1/4 | 1/4 |
| BX12-11- Periodic slow n | C1 | 1/2 | 1/4 |
| BX12-12- Single slow N | C1 | 1/4 | 1/4 |
| BX12-13- Periodic gamma | C1 | 1/4 | 1/4 |
| BX12-14- Single gamma | C1 | 1/4 | 1/4 |
| BX12-15- Single fast n | C1 | 1/4 | 0 |
| BX12-17- Periodic fast n | C1 | 1/2 | 1/4 |
| BX12-20- Vitality of mice | C1 | 1/4 | 1/4 |
| Care of animals | | 1/2 | 1/2 |
| Administration | | 1 | 3/4 |
| Reports | | 4 | 3 |
| | | <u>8</u> | <u>6</u> |

Allocation of Time - Non-Academic

| | | |
|-----------------------------------|-----------|-----------|
| Technicians - mouse weights, etc. | 2 | 2 |
| Clerical | 2 | 2 |
| Care of animals | 8 | 8 |
| | <u>12</u> | <u>12</u> |

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Per Letter Instructions of

AEC 3-27-53

HEALTH DIVISION

AND

BIOLOGICAL SECTION OF RESEARCH DIVISION

ms. for N.T. Bray
5/28/53 SUPERVISOR CENTRAL FILES
ORNL

* * * * *

REPORT FOR THE MONTH OF MARCH, 1946

BY

J. E. WIRTH, M.D., K. Z. MORGAN AND H. J. CURTIS

~~THIS DOCUMENT CONTAINS INFORMATION AFFECTING~~
~~THE NATIONAL DEFENSE OF THE UNITED STATES~~
~~WITHIN THE MEANING OF THE ESPIONAGE ACT, U.S.C.~~
~~30, 31 AND 32. REVELATION OF ITS CONTENTS TO AN UNAUTHORIZED~~
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March 29, 1946

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March 29, 1946

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CLINTON LABORATORIES
MEDICAL SECTION OF HEALTH DIVISION

BY

J. E. Wirth, M. D. - Medical Director

1. Medical Activities.

- a) Pre-employment and termination examinations have continued at a constant rate. Additional efforts are being put toward completing annual physical examinations to bring them up to date.
- b) Dispensary. Dispensary service has been on a continuous 24-hour basis. There have been two major accidents. However, neither was very serious, but required loss of time from work. The minor accidents have occurred in about the same rate.

2. Clinical Laboratory.

Blood and urine analyses have been continued on the new routine.

3. Special Hazards.

See Health-Physics report.

March 29, 1946

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CLINTON LABORATORIES

MEDICAL SECTION - - HEALTH DIVISION

J. E. Wirth, M.D. - Medical Director

DISTRIBUTION OF EFFORT FOR THE MONTH OF MARCH, 1946

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|----------------------------|-------------------|-------------------|
| Physicians | 3 | 5 |
| Medical Technicians | 9 | 8 |
| Nurses | 7 | 7 |
| Office Personnel | <u>5</u> | <u>5</u> |
| | 24 | 25 |
| <u>Allocation of Time</u> | | |
| <u>Physicians</u> | | |
| Physical examinations | 1 | 1-1/4 |
| Dispensary Service | 1 | 1-1/2 |
| Special Hazards Problems) | | |
| Haematology studies) | 1/2 | 1/2 |
| Research | 0 | 3/4 |
| Administration | <u>1/2</u> | <u>1</u> |
| | 3 | 5 |
| <u>Medical Technicians</u> | | |
| Blood studies | 4 | 3 |
| Animal pathology | 3 | 3 |
| Urinalyses | 1/2 | 1/2 |
| Clerical | 1/2 | 1/2 |
| General Laboratory | <u>1</u> | <u>1</u> |
| | 9 | 8 |
| <u>Nurses</u> | | |
| Dispensary shift nursing | 6 | 6 |
| Visiting nurse | <u>1</u> | <u>1</u> |
| | 7 | 7 |

March 29, 1946

MonH-86

CLINTON LABORATORIES

HEALTH-PHYSICS SECTION OF HEALTH DIVISION

BY

K. Z. Morgan - - Section Chief

Survey measurements during the preparation of enriched P-9 solution for the critical experiments indicated that the work was done with little increase in neutron activity and with an average air pollution of approximately 2% of tolerance.

The new urine analysis laboratory will not be ready for perhaps two or more months because of difficulty in procurement of materials. Meanwhile, two chemical processes for the detection of plutonium look promising, and it is hoped that preliminary reports on both can be written in another month.

On two occasions during the past month clothing that had been washed and released from the decontamination laundry was found to contain contaminated spots of about 12 mr/hr. In both instances the contamination was due to low energy beta and gamma activity which had not been observed by the usual laundry method of testing a folded garment with a G. M. counter. A revised laundry testing procedure is being considered.

The automatic steam jet from waste tank W-11 to W-5 failed on the night of March 5, 1946 and permitted steam to wash radioactive iodine into the air. An investigation of ringing alarms of the friskers at the restricted gates and in the instrument building led to a discovery of the radiation activity in the air. An air sample was collected from near the pile building which read about four times tolerance. The lack of wind and an atmospheric inversion combined to make the radiation level rather high in all the restricted area. Guards and others who had to work outside in the area of high radiation activity were rotated so they would not receive more than tolerance exposure. Some of the persons working in the restricted area during this period had thyroid counts which reached a maximum of about one-third tolerance. Changes have been made in the W-11 jet which are expected to prevent a recurrence of such an accident.

When a large ventilating fan on the east side of the semi-works building was started up, it sprayed contaminated water on persons outside the building. One person's head counted 340 c/m of beta and gamma activity after he had washed very carefully.

March 29, 1946

MonH-86

CLINTON LABORATORIESHEALTH-PHYSICS SECTION - HEALTH DIVISIONK. Z. Morgan - - Section ChiefDISTRIBUTION OF EFFORT IN MAN-MONTHS FOR THE MONTH OF MARCH, 1946

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|--|-------------------|-------------------|
| Physicists (Assoc. & Sr.) | 4 | 4 |
| Jr. Physicists & Research Asst's | 28 | 29 |
| Chemists | 1 | 1 |
| Junior Chemists | 2 | 2 |
| Laboratorians, Technicians & Secretaries | 24 | 24 |
| | <u>59</u> | <u>60</u> |

| <u>Allocation of Time during March</u> | <u>Weekly</u> | <u>Monthly</u> |
|--|-----------------------|----------------|
| <u>Services</u> | | |
| Pocket Meters | 8 | 0 |
| Badge & Ring Meters | 6 | 1/2 |
| Neutron Films | 2 | 1/2 |
| Hand, glove & shoe counts | 1 | 0 |
| Laundry counting | 2 | 0 |
| Calibration | 1 | 0 |
| Surveys - 100 Area | 0 | 1-1/2 |
| Surveys - 200 Area | 0 | 1-1/2 |
| Surveys - 706-A | 2 | 2 |
| Surveys - 706B, C & D | 0 | 8 |
| Mud, water & air surveys | 1 | 1 |
| Trainees | 0 | 4 |
| <u>Research & Development</u> | | |
| New Instrument development | | 1 |
| Instrument tests | | 1 |
| Slow neutron studies | | 1 |
| Fast neutron studies | | 1 |
| Methods of detecting product in urine | | 4 |
| Preparation of PFR | | 3 |
| Apparatus for Crossroad Tests | | 3 |
| <u>Administrative</u> | | 2 |
| <u>Office Personnel</u> | <u>1</u> <u>24</u> | <u>35</u> |

March 29, 1946

MonH-86

CLINTON LABORATORIESBIOLOGICAL SECTION OF RESEARCH DIVISIONBYH. J. Curtis - - Section Chief

Experiments with small periodic doses of fast neutrons and gamma rays on CF₁ mice have advanced to the point where threshold levels of dosage are being manifested. 0.115 n per day fast neutron treatments have been found to shorten the life span of these animals significantly and there is a suggestion that 1 r per day gamma ray exposures will have some effect.

At the time the present chronic experiments were undertaken, it was known that the r/n ratio for acute killing effects in mice was 7.5 to 8. The newer findings indicate that for chronic effects this ratio is 2 to 4 times greater, that is, the r/n ratio is 15 to 40 depending on values which are available only by extrapolation as yet. Several kinds of results in fact are being obtained which indicate that fast neutrons are considerably more effective than gamma rays in causing late than in causing acute damage.

March 29, 1946

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CLINTON LABORATORIESBIOLOGICAL SECTION OF RESEARCH DIVISIONDISTRIBUTION OF EFFORT FOR MONTH ENDING MARCH 31, 1946

| <u>Personnel</u> | | <u>This Month</u> | <u>Next Month</u> |
|------------------------|--|-------------------|-------------------|
| Research Associates | | 2 | 1 |
| Research Assistants | | 4 | 4 |
| Technical | | 2 | 2 |
| Non-academic personnel | | 8 | 8 |
| Clerical | | <u>2</u> | <u>2</u> |
| | | 18 | 17 |

| <u>Allocation of Time - Academic</u> | <u>Rating</u> | <u>Man-months</u> | |
|--------------------------------------|---------------|-------------------|----------|
| BX12-2- Periodic beta doses | C | 1/4 | 1/4 |
| BX12-11 Periodic slow n | C | 1/4 | 1/4 |
| BX12-12 Single slow n | C | 1/4 | 1/4 |
| BX12-13 Periodic gamma | C | 1/4 | 1/4 |
| BX12-14 Single gamma | C | 1/4 | 1/4 |
| BX12-17 Periodic fast n | C | 1/4 | 1/4 |
| BX12-20 Vitality of mice | C | 1/4 | 1/4 |
| Care of animals | | 1/4 | 1/4 |
| Reports | | <u>4</u> | <u>3</u> |
| | | 6 | 5 |

| <u>Allocation of Time - Non-academic</u> | | | |
|--|--|----------|----------|
| Technicians - mouse wts, etc. | | 2 | 2 |
| Clerical | | 2 | 2 |
| Care of animals | | <u>8</u> | <u>8</u> |
| | | 12 | 12 |

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145.56 M. Shirley

For: N. T. Bray, Supervisor
Laboratory Records Dept.

ORNL

HEALTH DIVISION

AND

BIOLOGICAL SECTION OF RESEARCH DIVISION

* * * * *

REPORT FOR THE MONTH OF APRIL, 1946

BY

J. E. WIRTH, M.D., K. Z. MORGAN AND P. S. HENSHAW

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April 30, 1946

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~~unauthorized person is prohibited by law.~~

April 30, 1946

MonH-102

CLINTON LABORATORIES
MEDICAL SECTION OF HEALTH DIVISION

By

J. E. Wirth, M.D. - - Director, Health Division

1. Medical Activities:

- a) General. A gradual change to a more permanent peace time basis is being planned for the Medical Section.

Work on the PPR has increased during this period.

- b) Pre-employment and termination examinations have continued at about the same rate.

- c) Dispensary. Dispensary service has been on a continuous 24-hour basis. Personal illness cases still cause about 75% of the dispensary work.

2. Clinical Laboratory.

Blood and urine analysis have been continued without any change in the last three months. Finger ridge impressions are being taken on new restricted area personnel who are likely to be handling active materials.

3. Personnel.

Doctor Jean S. Felton has been added to the staff in the position of Section Chief of the Medical Section.

4. Special Hazards.

See Health-Physics report.

This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, U. S. C. 50, e 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

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April 30, 1946

MonH-102

CLINTON LABORATORIESMEDICAL SECTION - - HEALTH DIVISIONJ. E. Wirth, M.D. - Director, Health DivisionDISTRIBUTION OF EFFORT FOR THE MONTH OF APRIL, 1946

| <u>Personnel</u> | <u>Monthly</u> | <u>Weekly</u> | <u>This Month</u> | <u>Next Month</u> |
|---------------------|----------------|---------------|-------------------|-------------------|
| Physicians | 4 | 0 | 4 | 5 |
| Medical Technicians | 1 | 7 | 8 | 8 |
| Nurses | 0 | 7 | 7 | 8 |
| Office Personnel | 0 | 5 | 5 | 5 |
| | 5 | 19 | 24 | 26 |

Allocation of TimePhysicians

| | | |
|------------------------------|-----|-------|
| Physical Examinations | 1½ | 1-1/4 |
| Dispensary Service | 1 | 1-1/2 |
| Special Hazards Problems) | | |
| Haematology studies) | 1/2 | 1/2 |
| Research | 0 | 3/4 |
| Administration & PPR Writing | 1 | 1 |
| | 4 | 5 |

Medical Technicians

| | | |
|--------------------|-----|-----|
| Blood studies | 3 | 3 |
| Animal pathology | 3 | 3 |
| Urinalyses | 1/2 | 1/2 |
| Clerical | 1/2 | 1/2 |
| General Laboratory | 1 | 1 |
| | 8 | 8 |

Nurses

| | | |
|--------------------------|---|---|
| Dispensary shift nursing | 6 | 6 |
| Visiting nurse | 1 | 1 |
| | 7 | 7 |

~~SECRET~~

~~SECRET~~

April 30, 1946

MonH-102

CLINTON LABORATORIES

HEALTH-PHYSICS SECTION OF HEALTH DIVISION

By

K. Z. Morgan - - Section Chief

Uranium slugs which had been left in the canal for about a year became spotted with a white material. Two of these slugs were examined for defects and the white material was found not to be due to chemical action on the aluminum walls of the slugs, but rather it was due to sediment from the water.

During the week of barium production run #10 in the 706-D building, there were ninety precipitron air samples taken by Health Physics. None of these samples indicated any significant alpha activity but nineteen of these had beta-gamma counts greater than 1,000 c/m. The highest sample gave 25,000 c/m of beta-gamma activity. The third level of the building was evacuated several times when the air activity exceeded the evacuation level of 10,000 c/m of beta-gamma. Indications are that a large amount of the air activity in this building is blown in from the 706-D stack outside the building.

Considerable construction work is getting under way at Clinton Laboratories. The workmen are required to wear film badges when inside the restricted area since they are at liberty to wonder about where they please. Generally speaking, we do not expect them to receive any radiation. However, one group of workmen uncovered a drain pipe reading about 500 mr/hr at its surface and in another case a power shovel operator was found working near the corner of a building that read 250 mr/hr, so it is not impossible for a few of them to receive some radiation exposure.

The old plutonium separations building (205) is in the process of being remodeled. Special safety precautions are taken in room D which has considerable plutonium contamination. Extensive use is being made of the air line hoods and the workmen find them more comfortable and more desirable than any of the other masks when they must be worn for extended periods.

A survey has revealed that there are a number of contaminated articles in the scrap lumber pile. Many of the contaminated objects were placed here in 1943 and 1944 before adequate facilities were available for extensive monitoring or burial. It has been decided to burn the scrap wood in the present pile and to establish a more carefully monitored scrap pile in the future.

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Mr. T. E. Bortner has mounted a number of the Lauritsen electroscopes in bakelite tubes 3-1/2" in diameter by 6" in length. The charging mechanism makes use of a variable condenser which is charged with a low voltage battery and builds up the necessary voltage as the capacity of the condenser is decreased. The total weight of the instrument is about 2-1/2 lbs.

Reasonably good checks between the ashing process followed by a CaC_2O_4 precipitation, and a direct CaC_2O_4 precipitation from urine containing Pu that had been through the human system have been obtained. Further work will be done to verify the efficiency of the CaC_2O_4 precipitation procedure.

The fast neutron film has been carefully calibrated by Mr. J. S. Cheka. Using the Victoreen "R" meter and the Aebersold factor, the fast neutron tolerance was found to be 21 tracks per 50 fields of vision. The slow neutron tolerance was found to be 14 tracks per 50 fields of vision. The microscope was used with a total magnification of 970 giving a field of vision of $1.77 \times 10^{-4} \text{ cm}^2$.

It was found that the insensitive ^{gamma ray monitoring} films in many of the recently received shipments turn a greenish color after being developed. Two films were taken at random from 35 boxes and developed. From this test it is estimated that over 60% of this shipment of films are unsatisfactory. This shipment of films was returned to du Pont.

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April 30, 1946

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CLINTON LABORATORIES

HEALTH-PHYSICS SECTION - HEALTH DIVISION

K. Z. Morgan - - Section Chief

DISTRIBUTION OF EFFORT IN MAN-MONTHS FOR THE MONTH OF APRIL, 1946

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|--|-------------------|-------------------|
| Physicists (Assoc. & Sr.) | 4 | 4 |
| Jr. Physicists & Research Asst's | 25 | 27 |
| Chemists | 1 | 1 |
| Junior Chemists | 2 | 1 |
| Laboratorians, Technicians & Secretaries | 27 | 27 |
| | <u>59</u> | <u>61</u> |

Allocation of Time during April Weekly Monthly

Services

| | | |
|-----------------------------|---|---|
| Pocket Meters | 8 | 0 |
| Badge & Ring Meters | 6 | 1 |
| Neutron Films | 2 | 1 |
| Hand, glove & shoe counts | 1 | 0 |
| Laundry counting | 2 | 0 |
| Calibration | 1 | 0 |
| Surveys - 100 Area | 0 | 2 |
| Surveys - 200 Area | 0 | 2 |
| Surveys - 706-A | 2 | 2 |
| Surveys - 706-B, C & D | 0 | 8 |
| Surveys - Construction Area | 0 | 1 |
| Mud, water & air surveys | 1 | 2 |
| Trainees | 0 | 0 |

Research & Development

| | | |
|---------------------------------------|---|---|
| New Instrument development | 1 | 1 |
| Instrument tests | 1 | 1 |
| Slow neutron studies | | 1 |
| Fast neutron studies | | 1 |
| Methods of detecting product in urine | | 3 |
| Preparation of PPR | | 2 |
| Apparatus for Crossroads Tests | | 2 |

Administrative

Office Personnel

2

2

27

32

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April 30, 1946

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CLINTON LABORATORIES
BIOLOGICAL SECTION OF RESEARCH DIVISION

BY

P. S. Henshaw - Section Chief

Exploratory experiments dealing with the late effects of phosphorus (P^{32}) beta rays on mammalian forms have yielded some unusually interesting information pertaining to methods of controlling the destiny of cells.

It has been reported previously that skin carcinomas will arise in the skin of rats at 8 to 12 months of life after single exposures of 4000 to 5000 rep of beta rays at 2 to 3 months of age. Certain of these animals show as many as 50 to 100 foci of neoplastic growth over the body surfaces. Further, these lesions display almost every type of skin manifestations - squamous carcinoma, adenoma, basal cell tumor, etc.

Having observed such malignant manifestations, one would expect that if the vital centers in tissues were being touched by an agent which would direct the nature of tissue activity along the various channels of malignant activity, this same agent should also direct some tissue activity along channels different from normal but not malignant. During the past month ample demonstration of such action has been seen.

Rats that received single doses of 4000 to 5000 rep of phosphorus beta rays at 2 to 3 months of age now show, in addition to the malignant lesions, duplication of claws on many of the toes. One of these toes two claws are present and are arranged more or less so as to oppose each other in somewhat the same manner as the claws of the crayfish cheliped. These accessory organs appeared where the toe pads would ordinarily have been. On one animal a chitinous appendage resembling a horn appeared. While this latter undoubtedly represented a piling up of squamous material, it is nevertheless interesting. In guinea pigs treated in a similar manner, hair 8 to 10 times normal length replaced normal hair.

These findings offer the hope that it may eventually be possible to purposefully guide cell behavior into more useful pursuits. It would appear that beta rays will be particularly useful in effecting changes in the skin. Innumerable basic biologic experiments are suggested by these findings.

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April 30, 1946

MonH-102

CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

By

P. S. Henshaw - - Section Chief

DISTRIBUTION OF EFFORT FOR MONTH ENDING 4/30/46

| <u>Personnel</u> | <u>This Month</u> | <u>Next Month</u> |
|------------------------|-------------------|-------------------|
| Research Associates | 1 | 1 |
| Research Assistants | 4 | 4 |
| Technical | 2 | 2 |
| Non-academic Personnel | 8 | 8 |
| Clerical | 2 | 2 |
| | <u>17</u> | <u>17</u> |

Allocation of Time - Academic Rating

Man-Months

| | | | |
|------------------------------|----|----------|----------|
| BX12-2 - Periodic beta doses | C1 | 1/4 | 1/4 |
| BX12-11 Periodic slow n | C1 | 1/4 | 1/4 |
| BX12-12 Single slow n | C1 | 1/4 | 1/4 |
| BX12-13 Periodic gamma | C1 | 1/4 | 1/4 |
| BX12-14 Single gamma | C1 | 1/4 | 1/4 |
| BX12-17 Periodic fast n | C1 | 1/4 | 1/4 |
| BX12-20 Vitality of mice | C1 | 1/4 | 1/4 |
| Care of animals | | 1/4 | 1/4 |
| Reports | | <u>3</u> | <u>3</u> |
| | | 5 | 5 |

Allocation of Time - Non-academic

| | | |
|--------------------------------|-----------|-----------|
| Technicians - mouse wts., etc. | 2 | 2 |
| Clerical | 2 | 2 |
| Care of animals | 8 | 8 |
| | <u>12</u> | <u>12</u> |

May 31, 1946

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HEALTH DIVISION

AND

BIOLOGICAL SECTION OF RESEARCH DIVISION

REPORT FOR THE MONTH OF MAY, 1946

By

J. E. WIRTH, M.D., K.Z. MORGAN AND P. S. HENSHAW

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md for N. T. Brown
5/24/53 SUPERVISOR CENTRAL FILES
ORNL

May 31, 1946

MemH-114

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May 31, 1946

MonH-114

CLINTON LABORATORIES

MEDICAL SECTION OF HEALTH DIVISION

By

J. E. Wirth, M.D. - Director, Health Division

1) Medical Activities:

- a) Pre-employment and termination examinations have continued at a slightly accelerated rate.
- b) Dispensary. Dispensary service has been on a continuous 24-hour basis.
- c) Administration. Seven new blank forms have been devised and are now being printed. They are

| | |
|---------|---|
| M-277-R | "Physical Examination Record" |
| M-315 | "Food Handlers Examination Record" |
| M-310 | "Medical Care - Daily & Monthly Report" |
| M-311 | "Daily Register of Patients" |
| M-312 | "Record of Non-occupational Injuries and Illnesses" |
| M-152-R | "Record of Injuries and Occupational Diseases" |
| B-429 | "Laboratory Procedures - Daily and Monthly Records" |

New forms are being devised so that within the near future a complete set of workable forms will be available in order to accomplish the following:

- 1. Accurate statistical records.
- 2. Accurate supply records showing maximum and minimum levels.
- 3. Work simplification, and a more efficient routing of patients.
- 4. A better conception of the medical care required by the Clinton Laboratories' personnel.

An Operating Manual for the Medical Section is being prepared. This manual will include standing orders for Industrial Nurses.

- d) Physical Facilities. Plans have been developed for moderate revision of the facilities of the Medical Section. Carpentry work on the Reception Room and Supply Room has been started. A small pharmacy has been located in a part of the supply room. The illumination of various working areas has been improved and a general house cleaning and removal of unusable surplus equipment has been effected.

2) Clinical Laboratory:

Blood and urine analyses have been performed on the previously outlined routine basis. Finger ridge impressions are being taken on new restricted area personnel. The reconversion of the laboratory for more general clinical laboratory work is being undertaken.

3) Special Hazards:

The general rules and procedures for the handling of active materials are being revised.

See Health-Physics Report for details of incidents during the month.

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CLINTON LABORATORIESMEDICAL SECTION - - HEALTH DIVISIONJ. E. Wirth, M.D. - Director, Health DivisionDISTRIBUTION OF EFFORT FOR THE MONTH OF MAY, 1946

| <u>Personnel</u> | <u>Monthly</u> | <u>Weekly</u> |
|--|----------------|---------------|
| Physicians | 4 | 0 |
| Medical Technicians | 1 | 7 |
| Nurses | 0 | 7 |
| Office Personnel | 0 | 5 |
| | <u>5</u> | <u>19</u> |
| Number of Technical Personnel added | 0 | |
| Number of Technical Personnel terminated | 0 | |
| <u>Allocation of Time</u> | | |
| <u>Physicians</u> | | |
| Physical Examinations | 1 1/2 | 0 |
| Dispensary Service | 1 | 0 |
| Special Hazards Problems) | | |
| Haematology studies) | 1/2 | 0 |
| Research | 0 | 0 |
| Administration & PPR Writing | 1 | 0 |
| | <u>4</u> | |
| <u>Medical Technicians</u> | | |
| Supervision | 1/2 | 0 |
| Blood studies | 1/2 | 2 |
| Animal pathology | 0 | 1 |
| Urinalyses | | 1/2 |
| Clerical | 0 | 1/2 |
| General Laboratory | 0 | 1 |
| Leave of Absence | 0 | 2 |
| | <u>1</u> | <u>7</u> |
| <u>Nurses</u> | | |
| Dispensary shift nursing | 0 | 6 |
| Visiting nurse | 0 | 1 |
| | <u>0</u> | <u>7</u> |

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CLINTON LABORATORIES

HEALTH PHYSICS SECTION OF HEALTH DIVISION

By

K. Z. Morgan - - Section Chief

The graphite stringer Number 21 became jammed in the pile on April 30, 1946. A spill of monopotassium phosphate occurred during the manipulation of the stringer due to a broken sample can. The contaminated area that resulted read 30 roentgens/hr. at 2 feet. The fastened sections of Stringer 21 were finally forced out of the north side of the pile into a lead shield and the hole was swabbed with damp mops. The highest precipitron sample during this operation read 55,000 c/m of beta plus gamma air activity or 5.5 times the recommended tolerance level. Persons engaged in this operation breathed considerable radioactive dust before the high air activity was discovered. The highest throat and chest count was 500 c/m of beta plus gamma activity as measured with the thyroid probe G.M. Counter.

Air activity in the Pile Building became excessive several times during the month. On May 22, 1946, the pile was shut down and the building evacuated for about an hour until the activity dropped to a tolerance level. Most of the air contamination was traced to the exhaust from the pneumatic tube. This condition has been rectified by connecting the pneumatic exhaust to the scanner exhaust.

On May 16, 1946, when a sample was taken from Sampler B-17 during the barium separation operation, a drop of the solution fell on a paper covering the floor. The nearest approach of a probe meter ($\sim 1/2$ inch) gave a reading of 100 roentgens/hr. The hands of the person who disposed of this contaminated paper were badly contaminated and his coveralls read 300 mr/hr at 1 inch. It took nearly an hour to decontaminate the operator's hands; $KMnO_4$ soaks followed by $NaHSO_3$ rinses being successful finally.

During the transfer of metal waste solution from Tank A-6 to W-9 on May 9, 1946, a leaking valve contaminated the ground in the vicinity to the extent of 10 roentgens/hr. at 1 foot. The area was roped off and the contaminated dirt removed to the burial ground.

When the piletto was constructed, the plans were followed and carefully studied by the Health-Physics Section to try to reduce the possibility of a future radiation hazard to a minimum. A recent inspection revealed that the piletto was being operated with four of the five control rods blocked out in order to make necessary neutron flux measurements. It is believed that the operation with

only one control rod is relatively safe, however, since the possibility of this rod jamming is rather remote and this rod is dropped automatically into the pile in case of power failure or excessive pile activity. The two monitrons which automatically release this control rod in case of excessive pile activity were found to have too large a time constant and to operate through a single relay instead of individual relays. These defects are being remedied. The other control rods are to be used when experiment permits.

Mr. J. H. Roberson tested the Victoreen pocket chambers with a radium source to determine the saturation potential (the potential at which >95% of the ions are collected). The saturation potential was 45 volts in a field of 13 mr/minute and 225 volts in a field of 480 mr/minute. In practice, these meters are charged to about 140 volts. At this potential saturation is 90% complete in a field of 480 mr/minute which gives a tolerance dose in 12 seconds. If these or similar meters are used to measure the radiation exposure to personnel during the short interval of the explosion at the "Crossroads" operation, corrections will have to be made for this saturation loss.

Mr. A. L. Baietti tested the Victoreen portable G.M. tube that is to be used during the "Crossroads" operation. It was satisfactory from the standpoint of temperature coefficient, and energy dependence, but refused to function after 20 hours in a room at 98% relative humidity. It began working again after placing it in a room at normal (~40%) relative humidity for two days.

A radium source (24.9 mg) was lost during the month. After considerable investigation the source was located and recovered in tact from the incinerator.

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CLINTON LABORATORIES

HEALTH-PHYSICS SECTION - HEALTH DIVISION

K. Z. Morgan - - Section Chief

DISTRIBUTION OF EFFORT IN MAN-MONTHS FOR THE MONTH OF MAY, 1946

| <u>Personnel</u> | <u>Monthly</u> | <u>Weekly</u> |
|--|----------------|---------------|
| Physicists (Assoc. & Sr.) | 4 | 0 |
| Jr. Physicists & Research Asst's | 27 | 0 |
| Chemists | 1 | 0 |
| Junior Chemists | 2 | 0 |
| Laboratorians, Technicians & Secretaries | 0 | 27 |
| | <u>34</u> | <u>27</u> |
| Number of Technical personnel added | 7 | |
| Number of Technical personnel terminated | 3 | |
| <u>Allocation of Time during May</u> | | |
| <u>Services</u> | | |
| Pocket Meters | 0 | 8 |
| Badge & Ring Meters | 1 | 6 |
| Neutron Films | 1 | 2 |
| Hand, glove & shoe counts | 0 | 1 |
| Laundry counting | 0 | 2 |
| Calibration | 0 | 1 |
| Surveys - 100 Area | 2 | 0 |
| Surveys - 200 Area | 2 | 0 |
| Surveys - 706-A | 2 | 2 |
| Surveys - 706 B, C & D. | 8 | 0 |
| Surveys - Construction Area | 1 | 0 |
| Mud, water & air surveys | 2 | 1 |
| Trainees | 1 | 0 |
| <u>Research & Development</u> | | |
| New Instrument development | 1 | 1 |
| Instrument tests | 2 | 1 |
| Slow neutron studies | 1 | 0 |
| Fast neutron studies | 1 | 0 |
| Methods of detecting product in urine | 3 | 0 |
| Preparation of PPR | 2 | 0 |
| Apparatus for Crossroads Tests | 2 | 0 |
| <u>Administrative</u> | 2 | 0 |
| <u>Office Personnel</u> | <u>0</u> | <u>2</u> |
| | <u>34</u> | <u>27</u> |

May 31, 1946

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CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

By

P. S. Henshaw - - Section Chief

Recent summaries of information obtained with CF₁, ABC, A, and C⁵⁸ mice given small daily doses of fast neutrons or gamma rays, have revealed the following:

1. In general, the late effects consisted of generalized atrophy and neoplasia of hemopoietic organs. Both of these effects were attended by shortened life span, loss of weight, possible increased tumor incidence in organs other than hemopoietic, modified blood picture, and a changed pathology and histology.
2. Generalized atrophy appeared to result from the inroads of subliminal damage which in time added up to the exhaustion of vital reserves. Neoplasia appeared to be a more unique biologic response which may or may not result directly from the atrophic condition.
3. By utilizing the various criteria of effects different thresholds of damage were found. Survival time, one of the most sensitive responses, showed effects following exposures in the range of 0.1 n of fast neutrons and 1 r of gamma rays.
4. Threshold responses of the peripheral blood were at least a factor of 10 less sensitive than survival responses in CF₁ mice.
5. Some differences were noted in the responses of different strains of animals but these were more a matter of degree than of type and usually could be associated directly with species characteristics.
6. No fundamental differences were observed in the responses of males and females to radiation, although the effects being studied were sometimes obscured by sex features such as pugnaciousness in CF₁ males.
7. The r/n ratio of gamma rays to fast neutrons for the different effects varied roughly from 8 to 1 to 2 or 3 times this amount for the conditions and methods used.
8. The accumulated evidence indicates that the degree of biologic effect varies not only with dose but also with the density of the ionization produced, irrespective of whether it is concentration with respect to space or time.

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CLINTON LABORATORIES

BIOLOGICAL SECTION OF RESEARCH DIVISION

By

P. S. Henshaw - - Section Chief

DISTRIBUTION OF EFFORT FOR MONTH ENDING 5/31/46

| <u>Personnel</u> | <u>Monthly</u> | <u>Weekly</u> |
|------------------------|----------------|---------------|
| Research Associates | 1 | 0 |
| Research Assistants | 4 | 0 |
| Technicians | 0 | 2 |
| Non-academic personnel | 0 | 8 |
| Clerical | 0 | 2 |
| | <u>5</u> | <u>12</u> |

| | |
|--|---|
| Number of Technical Personnel added | 0 |
| Number of Technical Personnel terminated | 0 |

| <u>Allocation of Time - Academic</u> | <u>Rating</u> | | |
|--------------------------------------|----------------|----------|----------|
| BX12-2 - Periodic beta doses | C ₁ | 1/4 | 0 |
| BX12-11- Periodic slow n | C ₁ | 1/4 | 0 |
| BX12-12- Single slow n | C ₁ | 1/4 | 0 |
| BX12-13- Periodic gamma | C ₁ | 1/4 | 0 |
| BX12-14- Single gamma | C ₁ | 1/4 | 0 |
| BX12-17- Periodic fast n | C ₁ | 1/4 | 0 |
| BX12-20- Vitality of mice | C ₁ | 1/4 | 0 |
| Care of animals | | 1/4 | |
| Reports | | 3 | |
| | | <u>5</u> | <u>0</u> |

Allocation of Time - Non-academic

| | | |
|--------------------------------|----------|-----------|
| Technicians - mouse wts., etc. | 0 | 2 |
| Clerical | 0 | 2 |
| Care of animals | 8 | 8 |
| | <u>0</u> | <u>12</u> |